abc OF SOCIAL AND POLITICAL KNOWLEDGE

WHAT IS the Scientific and Technological Revolution?

G. MARINKO

PROGRESS PUBLISHERS

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ABC СОЦИАЛЬНО-ПОЛИТИЧЕСКИХ ЗНАНИЙ

Г. И. Маринко

ЧТО ТАКОЕ НАУЧНО-ТЕХНИЧЕСКАЯ РЕВОЛЮЦИЯ?

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Chapter One SCIENTIFIC AND TECHNOLOGICAL REVOLUTION—PROLOGUE OF A NEW CIVILISATION

Impressive, indeed, is the road mankind has travelled to arrive at the threshold of the third millennium. Having tamed and placed at his service Nature's powerful forces, man's intellect and labour have been embodied and perpetuated in civilisation's superb creations. A few thousand years ago man struggled for his subsistence employing primitive stone tools, awe-stricken at each clap of thunder and streak of lightning, pleading for mercy with Spirits and Gods, weak and helpless in the face of formidable elements. Today, man has learned to control many diseases, penetrated into the

depths of the micro- and macroworld, escaped from the cradle of the Earth, visited the Moon and is now busy preparing to utilise for practical purposes the near-Earth space and embark upon a journey to the stars, unraveling the mysteries of living matter, creating the state-of-the-art equipment and wonders of culture.

As an ancient Greek myth goes, Prometheus, the son of Gods, stole fire from them and gave it to the human race. He taught man crafts and the beginnings of arts. In a word, he awakened in them the spirit of search and creativity, giving them strength to become masters of the world. The Gods could not forgive Prometheus for his daring disobedience and chained him to a rock, dooming him to eternal suffering and hoping that without his "benefactor" and "teacher", man would be helpless. But they have proved to be far from far-sighted. As he developed, man reached heights from which Prometheus' deeds look today quite infinitesimal.

Man's creations and the changes he has wrought in the world around him are innumerable. But what is most important, he has demonstrated that his intellectual and creative abilities are truly inexhaustible. At the same time, this mighty and all-powerful man has been still unable to solve quite a few of his vital and urgent problems. Millions of people are still suffering from hunger and dying of malnutrition and dis-

ease. Many people in even rich and prosperous countries are homeless. They do not have an opportunity to get an education, jobs, a refuge in old age, a decent living generally. The most hazardous types of weapons, such as nuclear arms, have been developed and are being perfected. Plans are being made to station them in outer space. Secret laboratories are busy working out chemical and biological weapons. Compared with their aftermath, plague and cholera, which in the past wiped out entire nations, would look like mere ailments. Military conflicts going on for years and threatening to turn into a world-wide conflict, flare up in one part of the world after another.

How to give scope to man's creative and intellectual forces, prevent a nuclear holocaust and solve many other intricate problems — this is the most imperative task facing the present stage of scientific and technological progress, which is a leading factor of world social development. The mid-twentieth century witnessed the beginning of a qualitative transformation in the entire system of the productive forces, which was later termed the scientific and technological revolution (STR). That revolution is a major development of our age, whose significance continues to grow steadily. As a result, science, technology and the productive potential have attained a historically unprecedented level of development. The STR

has swept all walks of life, destroying established concepts about our milieu and greatly intensifying the already rapid progress of humanity.

And indeed, as a prominent US sociologist, Alvin Toffler, suggests, if we measure the past 50,000 years of mankind's existence using as a yardstick the number of generations (the lifetime of each of which averages 62 years), we shall get a very interesting and impressive result: there were some 800 such generations in all. The first 650 lived in caves. Written language and communication between people have been known only to 70 generations. Man has been familiar with printed matter only in the lifespan of six generations, and the electric motor is known only to the last two generations. The bulk of present-day material and spiritual values has originated during the lifetime of the present generation. The industrial period, when the basic mass of material and cultural values was created, compares with the entire history of society as two days compare with the full lifetime of a 60-year-old person.

The world of today, with its unprecedented level of development of human civilisation, stands on the verge of still more grandiose accomplishments, social changes, cultural and technical innovations. The scientific and technological revolution opens up before man new

and unheard-of possibilities for re-making Nature, creating enormous material wealth, and enhancing man's abilities many times over. The impact of the STR is felt in all spheres of activity of contemporary man. It gives a new dimension to material production, affecting social and cultural processes and actually changing man's way of life. There is not a single walk of life which does not experience that impact of science, engineering and technology. Today, it is hardly possible to give an exhaustive and adequate assessment of numerous, long-range and socially profound implications the scientific and technological revolution entails.

1. What Is the Scientific and Technological Revolution?

The scientific and technological revolution (STR) is a complex and many-faceted phenomenon. As it develops, it increasingly reveals its ever new aspects and qualities. Its beginning is usually associated with such tremendous achievements as the development of the first automated production line, nuclear-engineering plant, computers, the launching of the first Earth satellite, chemical synthesis to obtain materials with preset characteristics, microelectronics. The STR marks a qualitative, radical change in the integ-

ral system of the productive forces caused by the internally consistent and integral process of the development of science and technology. It is an intricate, socially and economically determined phenomenon in society's life, a long-range historical process, in the course of which the technological basis of production undergoes qualitative change, as do the tools, subjects, character and content of labour.

Both in the past and at present the concepts of "scientific and technological revolution" and "scientific and technological progress" have been sometimes used as synonyms. Indeed, these concepts are synonymous, being closely associated with each other. But they are not identical. Speaking of the relationship between scientific and technological progress and the STR, it should be noted that the latter represents the core of present-day scientific and technological progress, being responsible for qualitative changes in the development of science and engineering and in their ties with each other and with production. These concepts must not be lumped together if only for the reason that since their rise, science and technology have been progressing continuously, uninterruptedly, while revolutions occurred in them only from time to time. Being an integral, consistent and progressive form of development of science and technology, scientific and technological progress proceeds both

revolutionarily and evolutionarily, but in a single historical stream.

The contemporary scientific and technological revolution has not been caused by any particular scientific discovery or technological innovation. Its source is the swift progress of scientific knowledge as a whole, spurred on by the impact of the requirements of material production, the vigorous transformation of science into a direct productive force and its enhanced role in developing engineering, production, and society generally.

In a word, the STR is an indispensable element of the natural historical process of development of productive forces, science and technology. The ground for it has been prepared by the general progress of machine-based production. Today, too, it greatly stimulates further development of the STR, marking a transitional stage from mechanised to automated production. Another prerequisite for it was the advancement of theoretical knowledge. A revolution in natural sciences which took place in the late 19th and early 20th centuries and resulted in a deeper scientific insight into the microworld, in a radical revision of outdated views concerning the structure of matter and the drawing up of a fundamentally new pattern of the atomic structure, had also greatly contributed to the STR. Of immense significance for it were the achievements

in mathematics, chemistry, biology and other sciences scored as a result of the revolution in natural sciences. It was a high level of development of natural sciences that was responsible for the new breakthrough in scientific knowledge that we witness today as a salient feature of the scientific and technological revolution.

Revolutions in science and technology took place in the past as well. However, they did not coincide in time, failing to merge into one whole. Thus, the first revolution in science began in the latter half of the 15th century. It purged science of scholasticism and laid the groundwork for modern natural sciences. However, that revolution, which lasted almost until the 18th century, was not accompanied by a revolution in technology which had hitherto been developing empirically, that is, only through man's own practical experience. Technical discoveries were made, as a rule, after a prolonged empiric search, while scientific ones were the sporadic products of solitary scientists, and it took a long time before they were applied in practice.

By the close of the 19th and the beginning of this century, a new revolution took place in science — the electron was discovered, as well as the mechanism of the transformation of atoms of one element into the atoms of another. The correlation between mass and energy was established. This had a considerable impact on the develop-

ment of technology, but did not cause a revolution in it.

As distinct from the past, the achievements of science today find their way into production at a much faster rate. And as the gap between scientific discoveries and their practical use has narrowed, the revolution embraces simultaneously the spheres of science and technology. For that reason it has been termed the scientific and technological revolution. Modern revolutions in science and technology not only coincide in time. Characteristic of them is a deep interconnection and interaction of processes, entailing profound and fundamental changes in all the main areas of science, technology and production, with science playing the leading role.

Another distinctive feature of the present-day scientific and technological revolution consists in that it bears an all-embracing character. For the first time, it embraces simultaneously most of natural and technical sciences, involving humanities as well. Outstanding discoveries in nuclear physics have provided knowledge of the innermost law-governed processes in Nature, advancing new ideas concerning the structure and properties of matter. A revolution in physics has inaugurated a breakthrough in all natural sciences. This process grows increasingly broader, extending to ever new sciences dealing with natural laws and phenomena and stimulating a tempes-

tuous development of mathematics, chemistry, biology and other sciences.

It is hardly necessary to list all the numerous directions in which contemporary scientific and technological progress develops. It is important to stress that interaction of science and technology has become so close one may make so bold as to speak of a single process of their development, that is, of the process of the scientific and technological revolution. On the one hand, all main achievements of modern technology derive from fundamental natural-science research, science increasingly becoming an industry having a growing impact on technology. On the other hand, scientific progress largely depends on industrial progress and requirements of production. Fruitful research and the ability to cognise many natural and social phenomena are largely determined by the technical standards of research institutions, their having the latest apparatus and equipment. The reciprocal impact of science and technology results in an accelerated development of both.

The all-embracing character of the STR is indicated by the fact that its impact is felt by practically all spheres and areas of society: production, management, transport, construction, communications, the armaments industry, information media, etc. It has an impact on man, too, his proficiency, intellectual and educational stan-

dards, way of life and culture, on society's structure, domestic and foreign policies of states, international relations generally, and on the economic competition between socialism and capitalism.

2.The Productive Force of Science

A cardinal, fundamentally novel change in the productive forces that characterises our time brings about the fusion of science and technology, science and material production generally, the transformation of science into a direct productive force. Today, science actually embodies Francis Bacon's famous postulate "knowledge means power", which that father of empirical natural science of modern times formulated some four hundred years back. From sheer contemplation and philosophising, science has been transformed into an effective practical, and productive force.

And indeed, if we tried to trace the roots of man's modern material creations and his practical accomplishments of any significance, we would inevitably discover them in science. The launching of man-made satellites, vaccines preventing grave diseases, which in the past took millions of lives, ocean and supersonic airliners, computers, robots, modern factories and many

other of man's creations would all have been inconceivable without research, without the preceding activity of numerous research and development centres and laboratories employing thousands upon thousands of scientists and researchers.

Over a hundred years ago, Karl Marx formulated the idea of science turning into a productive force. Science is becoming a productive force precisely because it, just like technology, multiplies man's creative abilities. Embodied in machines and technology, in the experience and skill of workers themselves, scientific knowledge sets into motion powerful forces for creating and building up society's wealth which immeasurably surpass all human and natural resources and the productive forces used hitherto. It is thanks to science that the world is changing literally before our eyes.

What, then, are the specific ways of transforming science into a direct productive force in conditions of the scientific and technological revolution? Scientific knowledge is being materialised in machines and technology, in the objective conditions of production, on the one hand, and in the creative abilities of the broad mass of workers, on the other. Lastly, it helps define the principles of organising and managing production and society. However, if we take not only scientific knowledge, but science as a whole, we

see that the process of science turning into a direct productive force also implies that scientific-research units are gradually incorporated into industry as its major element, entering directly and immediately into material production.

If we consider the impact of science on the worker and the organisation of production, here the range of scientific disciplines being directly involved in production is much wider. Today, they comprise not only the applied departments of mechanics, physics, chemistry, and biology, but also a number of social sciences. Modern production is unthinkable without economics and the science of management. Today no one is surprised to find sociologists, art designers and psychologists next to workers and engineers. Such sciences as mathematical logics, ecology, science and engineering forecasting, and other disciplines which seemingly have nothing to do with productive activities, also play a role in the development of production. As an element in the system of the productive forces, science plays its part in developing all its components, including man, the entire range of his labour, productive and social interrelations. And it is precisely the orientation of science on personality, the embodiment of scientific knowledge in the intellect, world outlook and creative abilities of practically all sections of working people, that marks a new histor-

ical stage in the development of science as a social institution. This, in turn, contributes to science developing at this juncture as a single and integrated system, whose central problem is man.

A salient feature of modern science is that it passes from the predominantly extensive to the intensive road of development. In particular, this means that it grows basically thanks to an improved organisation of researchers' labour, optimisation of principles and methods of science management, a more rapid and more efficient realisation of scientific ideas in production.

Being embodied in ever better machines and equipment, higher skills, and more rational organisation of production, new knowledge is ultimately materialised in social production, in material values and all kinds of services, traditional or non-existent before.

But what are the distinctive features of the modern product? What new characteristics does it acquire as a result of the impact of the STR on material production? The STR imparts a new dimension to production technology, which is of tremendous economic significance, making it science-intensive. Industries have appeared which we call science-intensive industries. Thus, in the USA, such industries include those where the average rate of spending on research and development (R&D) considerably exceeds that in the

manufacturing industry, where it amounts today to 2.4-3 per cent of the cost of the finished product. For the computer industry, for one, the relative rate of such spending is twice as much as the average rate in the manufacturing industry, ranging from 5 to 7 per cent, while in the aerospace industry that indicator is as great as 12 per cent of the cost of the finished product.

It should also be noted that knowledge as a productive force has this unique feature: no matter how much it is used in production, its volume does not diminish in the process. For scientific ideas do not die, nor are they scrapped as is the case with outdated technical equipment. They live on, combining with new ideas or serving as the basis for new theoretical principles and concepts.The discoveries made by Isaac Newton and Galileo Galilei, Michael Faraday and James Clerk Maxwell, Ernest Rutherford and Pierre Curie, Nikolai Lobachevsky and Albert Einstein, continue to serve science and engineering, providing instruments for new theoretical discoveries and materialising in computers and robots, satellites and spaceships, automobiles and lathes.Machines, plants, and technologies embody the labour of many generations of scientists, researchers and scholars.

This peculiarity of scientific knowledge as a productive force of society implies that no mat-

ter how great the initial allocations for research and technical innovations may be, applied in batch production they precipitately diminish if calculated per unit of output and are usually covered in a relatively short span of time. And even if means invested in research and development are not recovered immediately by creating a particular product (and "useless research", that is, research not yielding positive results is estimated today to be at least 70 per cent), these means are not in vain. They are not money thrown to the wind. The point is that scientific and technical innovations associated with the production of a particular item on the basis of a new technical idea are sure to yield a collateral effect in other lines of output, raising their technological standard.

When we speak of science turning into a direct productive force of society, we mean science as a whole, whose main goal is to obtain new and objective knowledge about Nature, society and man. And it would be a grave mistake to counterpose applied sciences to fundamental research, and natural sciences to social ones. To do so would be wrong not only because many social sciences, or fundamental research with little hope of being ever applied, do make direct or indirect contributions of their own to social production. The main thing is that science as such can develop effectively only if it does so as an integral or-

ganism, and this integrity grows apace with the development of scientific knowledge.

3. Main Productive Force of Society

In considering the scientific and technological revolution, it would be worthwhile to indicate the basic areas where it occurs. Thus, the present stage of the STR is characterised by the development of microelectronics and informatics, comprehensive automation and robotisation of production, use of new materials and technologies, the tapping of new sources of energy, development of biotechnology, etc. But by listing these and many other areas of the STR, we would not get an integral idea of its substance. For it was not for nothing that we defined it as a qualitative, radical upheaval in the entire system of the productive forces. And the latter include, first and foremost, man with his ability to work and create material and spiritual values. Without man there can be neither science nor technology.

Science and technology constitute those means which enhance man's strength and the potentiality of his hands and brain. Man sort of fixes and preserves the results of his intellectual development in technology and science. For that reason, the historical progress of technology and science

is but one side of the development of man as the main productive force of society.

The level reached by scientific thought and technology gives us a fairly clear idea of the various historical stages humanity has gone through. We marvel at the technological art of the Cro-Magnon man, his knowledge of the properties of materials from which he made his flint blades and spear-points comparable in sharpness to swords of Damascus steel. We cannot but appreciate and admire the grandeur and technical perfection of Egyptian pyramids, Mayan culture, and we look with reverence at the ruins of ancient structures. The mute witnesses of their times, these technical accomplishments have much to tell a modern investigator. It is, perhaps, with the same feelings that our posterity will look at the mock-ups of first aircraft and spaceships, nuclear power stations, watching the video-tapes showing the docking of spaceships and the lowering into the ocean depths of deep-sea apparatuses, scrutinising the numerically controlled lathes and first computerised devices.

Technology has such a tremendous impact on man's imagination that sometimes it seems to him that it is an independent force governing the development of human civilisation. And, indeed, under the impact of the STR, modern technology turns into a most complex system, engulfing all spheres of society's life. But its growing com-

plexity notwithstanding, its rise and development, and its fundamental changes wrought by the STR cannot be properly grasped unless they are viewed in close contact with the history of development of man himself. And although technical development is in many respects governed by its own innate laws concerning technical devices and systems, many key elements of that development are determined by the fact that man steadily transfers an ever greater part of his work operations to machines and equipment, which are constantly improving.

In any modern automatically operated device, its historical prototype — man with his tools — is readily discernable, and this despite its outer dissimilarity. Particular mechanisms represent the automation's muscles, its electric energy — the driving force, its electronic soft- and hardware — the nerves and the brain. Steadily automating his working functions, man continues to transmit them to machines, himself increasingly switching to the performance of new and more complex functions, which subsequently become also technicalised. Successive transmission of man's working functions to machines and equipment leads to the entire system of society's productive forces being restructured and elevated to a qualitatively new level.

How then do things stand today as regards this problem in the context of the STR? What work-

ing functions are being transferred to machines and equipment? Whereas the process of transition from handicraft tools to machines witnessed the transmission to the latter of functions of the direct control of tools, today we see a sweeping process when machines, technologies and production generally take over the functions of servicing and controlling themselves. In the process of automation, man takes his place alongside the direct technological cycle of production, ceasing to be its main agent.

In its development, automation sort of passes through three successive stages. At the initial stage of partial automation, it is represented by individual pre-set control lathes and individual automatic production lines outfitted with control devices. Here machines take over from man the functions of controlling themselves. At the second stage, it is already the functions of controlling production processes that are transmitted from man to machines and equipment. This is the stage of comprehensive automation exemplified by an automatically operating factory. And then comes the third stage of complete automation, when all components of production from designing and development to the supply of finished products function automatically. The case in point are modern flexible manufacturing systems, although they are still far from the ideal of full automation and are few in numbers.

But does this mean that man generally ceases to be the main productive force of society? Of course, not. What is actually taking place is the redistribution of functions. Releasing himself of many manual functions of controlling and servicing machines, man increasingly turns to the working out of programmes for computers which control production processes, to the making of managerial decisions, improving existing and developing new equipment through research and development. The main role in modern automated production is today played by programmers, adjusters, operators, technologists, designers, the personnel versed in electronics and systems, management experts, researchers, and experts in ergonomics.

Clearly, the place of pride goes here to versatile technical and scientific knowledge, the ability to think and act constructively, the discipline, responsibility, and initiative of workers. For now it is not a single lathe, but entire complexes of automatically operating units that man has to control. Under these circumstances, the intellectual standards of an individual become a factor determining the productive force of labour, raising many times its efficiency. As technology develops it becomes increasingly more evident that no matter what level of perfection it reaches, man remains the main productive force of society. The scientific and technological revolution,

which gives a new dimension to man in the system of modern production, transforms him from the "appendage" of a machine into a major and active factor of the production process.

4. Science and Technology—Bliss or Evil?

The scientific and technological revolution greatly differs in scale from revolutions in science and in technology that took place in the past: it is a global revolution. Ushered in by the needs of the further progress of the productive forces, science and engineering, the STR is unfolding simultaneously in capitalist and socialist countries, exerting an impact on developing countries as well. Beginning in the more developed states, it is gradually extending to ever new countries. As it asserts itself, all peoples of the world begin to partake of its fruits in one way or another.

The scientific and technological revolution proceeds at a time when mankind is passing from capitalism to socialism, when two socio-economic systems—the world socialist system and the world capitalist system—co-exist side by side on our planet. And since the STR has a great impact on the various aspects of society's life, and primarily, on material production, from the very outset it has become an arena of contest between socialism and capitalism. It should be further not-

ed that, although of a global nature, the processes given birth to by the STR manifest themselves differently in the different socio-economic systems.

In present-day conditions, the scientific and technological revolution acts as a powerful accelerator of social progress. While scientific and technological progress is highly conducive to the perfection of socialism, it simultaneously deepens and aggravates contradictions inherent in state-monopoly capitalism, giving rise to new contradictions typical of the present stage of its development.

And, indeed, microelectronics, computerisation, automation, and biotechnology—those leading areas of science of the 20th century — not only provide man with potentialities to solve a number of urgent problems, but confront him with serious problems which either crop up under the impact of the STR or are exacerbated by it.

The computer "replaces" man, while automation "relieves" him of the need to take a direct hand in material production. Where then is the place of man himself? What happens to him? In the age of electronics and informatics, computers and robots, capitalism just makes new millions of people redundant. Redundancy afflicts not only the youth, not only the unskilled labour. It affects those who only recently considered themselves

to be irreplaceable, e.g., draftsmen, designers, highly skilled assembly workers, welders, and workers of other trades, which have become unnecessary. A new term has been coined, "the new poor", meaning those who recently listed themselves among the "middle class", with roof over their heads and well-paid jobs, but who lost all overnight, joining the ranks of the "traditionally poor". The rich grow richer, the poor, poorer still—such is one of the inevitable consequences of scientific and technological progress in modern capitalist society.

The naive notions of scientific and technological progress being an irresistible force pushing society upward the ladder of social progress gave way to more cautious attitudes to the potentialities of science and technology. More than that, it became clear that they could bring about not only the deliverance of humanity from many maladies of modern civilisation, but plunge it into the vortex of calamities and disasters capable of blotting out the entire history of mankind. The contradictory nature of scientific and technological progress derives from the internal process of development of science and technology, and even more so, from the impact of social conditions. For the current generated by nuclear power stations and the cloud of the Hiroshima blast have one and the same origin—the same physical phenomenon described in the same physical equations.

But one can easily see what a tremendous difference these two physically identical processes make to mankind. The horror of the atomic explosion is still haunting those who miraculously survived it and many of those who directed and dealt the world's first atomic strike against the Japanese cities. But today, the sum-total of nuclear warheads amassed in the world is estimated at 12,000 megatonnes of TNT, which is a million times greater than the explosive charge of the A-bomb that wiped Hiroshima from the face of the earth.

Achievements of biotechnology make it possible to solve the acute food problem, create miraculous medicines, wipe out lethal diseases and tap new sources of energy. But here, too, there is an alternative. Development of biological and chemical weapons from which there will be no escape, manipulation of man's consciousness by means of special psychotropic preparations, and creation of zombies ready to obey the evil genius—all this is not the nightmarish fantasies of the sick mind or images created by monster films. All this is quite feasible if the results of modern biotechnology are put to inhuman uses. Hunger, war, droughts and floods, a direct threat to man's physical and spiritual world—these are also possible implications of the development of science and technology.

Scientific and technological progress has ap-

peared before man as a two-faced Janus, and it is still problematic which of his faces the man of the closing 20th and the coming 21st century will see. And this is not just theoretical philosophising, it is an actual, practical problem concerned with our understanding of what social justice, the trends of social development, and the humanitarian ideals corresponding to the substance of the human race should be.

The STR stimulates the competition of the two socio-economic systems. For it is a matter of which system — socialist or capitalist — will be able to take advantage more rapidly and more fully of the potentialities latent in technical and cultural innovations, ensuring faster rates of society's development and revealing amply the potential of the human factor. What is at stake in the present day social and political competition is the ends for which the fruits of the STR will be used. The contradiction with which humanity has arrived at the threshold of the 21st century consists in that science and technology, which possess enormous potentialities enabling them to make society prosperous, under the impact of class egoism in capitalist society, turn against man himself.

It stands to reason that scientific and technological progress and application of its results cannot be neutral socially: it is directly predicated on social conditions. Furthermore, it itself clearly

begins to "prompt" the nature of those social relations and features of social reality on which its trends of development hinge. The need is especially felt today for social conditions that would offer the best possible opportunities for the realisation of the demands advanced by the STR itself, making it possible to use its achievements purposefully, in behalf of man.

5. Social Significance of the STR

The scientific and technological revolution proceeds at a time when the world community is making dynamic progress. It forms part and parcel of that process, being an indispensable stage in society's onward movement. Socialist revolutions of the 20th century, which resulted in the emergence and development of the socialist world system, have opened broad vistas for the not yet fully unfolded social and political progress of the socialist countries, while the revolution in science and technology has ensured their scientific and technological progress. Under socialism, these two processes forge ahead in a single direction, enriching and complementing each other. Furthermore, in socialist countries scientific and technological progress is consciously placed in the service of social progress, the STR achievements being used purposefully and in a plan-

based manner to build up the material and technical basis of the new society.

As it develops under capitalism, the STR is increasingly handicapped by the relations of private ownership. Tending to develop infinitely, it comes up against the narrow framework of the prevailing relations of production. In bourgeois society, the deep antagonism between labour and capital affects adversely the development of the STR as well, its achievements largely benefitting not society as a whole, but capitalist monopolies, which use them to strengthen the positions of big capital, intensify exploitation of working people and rake in ever higher profits. Under capitalism, the scientific and technological revolution proceeds spontaneously and is accompanied by greater unemployment, inflation, higher prices of foodstuffs and consumer goods, the aggravation of the energy crisis and the coming to a head of the ecological crisis. The achievements of the STR are employed by monopoly capitalism for intensifying the arms race, for triggering local and regional military conflicts and for aggravating international situation. All this intensifies the struggle of all progressive forces against the power of monopolies and for peace, democracy, and social progress.

As we see, the STR is playing a tremendous role in accelerating contemporary social development, paving the way to new productive forces

commensurate with communist production relations. It creates prerequisites for a future historical leap from the kingdom of necessity into the kingdom of freedom. Thus, the social revolution and the scientific and technological revolution are but two interdependent sides of the single historical process, complementing each other.

The STR unfolding before our eyes has significance for, and exerts an impact on, mankind's progress. Once again it proves the correctness of Marxist-Leninist teachings concerning social progress, which, in the final analysis, is determined by the development and improvement of the productive forces of society. At the same time, it strikingly refutes the technocratic counterposing of the technological to the social revolution.

Historical experience demonstrates that the development of the productive forces is not simply a process of slow and evolutionary expansion. It necessarily passes through qualitative, revolutionary upheavals — technological revolutions. Marxism provides us with a profound and comprehensive understanding of the character and depth of the impact of technological breakthroughs on the entire social structure and its changes, including the dialectics of technological and social revolutions.

An agrarian revolution, which in the Neolithic era marked the transition from hunting and gathering to land cultivation and animal hus-

bandry, was the first technological revolution in the history of human society. This radical, qualitative upheaval in the development of the productive forces of society served as the indispensable material and technological condition for the subsequent social change, a social revolution, which resulted in the transition to early slave-owning civilisations, the rise of classes and the state.

The industrial revolution of the late 18th and early 19th centuries laid the material and technical foundations of capitalism and was the second technological revolution in mankind's history. Analysing its driving forces and social consequences, Karl Marx arrived at a general conclusion applicable to the entire history of human society. He noted that "alongside a revolution in the productive forces which occurred once and which represents a technological revolution, there takes place also a revolution in the relations of production".[1]

In this way, both the agrarian and the industrial revolutions were inseparably connected with social revolutions, laying the material and technical groundwork for a qualitatively new and more progressive social and economic struc-

[1] Karl Marx, "Zur Kritik der Politischen Ökonomie (Manuscript 1861-1863)"; in: *MEGA*, Abt. II, Bd. 3, Teil 6, Dietz Verlag, Berlin, 1982, S. 1973.

ture of society. A similar conclusion can be made as regards the scientific and technological revolution which began in the mid-twentieth century and which is not a mere coincidence in time of the revolution in science and the revolution in technology. It represents a fundamentally new breakthrough in the development of the productive forces, a technological revolution of our time. And just as was the case before, the technological and social revolutions presuppose each other, but vary from country to country chronologically. The modern STR develops both in the womb of capitalist society and in countries of victorious socialism, but in both cases it is considered to be a component of the revolutionary transition from an antagonistic-class to a classless society.

Deriving, in the long run, from the level of development of society's productive forces, the technological revolutions included profound social changes and social revolutions are characterised by a complex dialectical interconnection and a certain degree of independence. The inner logic of technological progress and a definite inner pattern of the development of the STR form the objective basis for a relatively independent development of productive forces and production relations. Therefore the dialectical unity of technological upheavals and social revolutions is expressed in man's history not in their strictly successive

order in all countries. That unity means that no new social system can assert itself and reveal all its potentialities without leaning on a corresponding material and technical foundation, on the one hand, while a revolutionary technological upheaval, even if it begins in the womb of the old social system, cannot but cause serious changes in it, on the other.

The way the contemporary scientific and technological revolution develops corroborates this proposition. The differences observed in the character of its development and the different social consequences it brings in its wake reveal that it strengthens socialism, being the basis of its improvement, and, at the same time, aggravates capitalism's contradictions, although it gives it a new lease of life for a certain period. The development of the STR as a technological upheaval of our time inevitably leads to the emergence of fundamentally new production relations conforming adequately to the essentially new productive forces.

The scientific and technological revolution is part and parcel of this profound social upheaval.

Chapter Two SCIENTIFIC AND TECHNOLOGICAL REVOLUTION— A BREAKTHROUGH INTO THE 21st CENTURY

The present stage of the STR is characterised by the vigorous development of microelectronics, informatics, biotechnology, comprehensive automation and mechanisation of production, the promising results of mastering the energy of thermonuclear fusion and other sources of energy, and application of materials and technologies that have been nonexistent before. Our century has had many appellations — the nuclear or space age, the age of informatics or microelectronics, the age of robots or automation. This, perhaps, reflects not only the profound changes through which the human civilisation of the 20th century passes, but also an age-old

striving to define clearly and precisely what is actually taking place in science and engineering, what is exerting such a powerful impact on all facets of our being.

If today we still speak of microelectronics and informatics as the vanguard technologies of the end of the 20th century, we can already see "new departures" capable of altering the world's entire picture. Biotechnology clearly aspires to the role of the "favourite" of the '90s. Recent developments in the sphere of superconductivity are also a real breakthrough. It is quite probable that in the near future all our ideas about the progress of science, technology and production will undergo radical change. The rates of development have become so tempestuous that any attempt to define, if only approximately, the main directions in which scientific and technological progress will forge ahead, has little chance of success.

1. What a Computer Can Do

Computer software and hardware, which until recently were accessible only to a fairly narrow group of scholars and experts, are steadily making its way into all walks of life. Recall the first electronic watches. The very idea that the time-honoured mechanisms could be dispensed with

and replaced by a cheap electronic battery, stunned the mind. Today, such watches cause no surprise, more complex microprocessors have appeared capable of controlling everything — from personal computers to electric coffee-mills and cars.

Computers began their career as an aid to scientists who were elaborating research and technological projects, unique for that time, in need of a tremendous volume of calculations. Today, computers are just ordinary tools of ordinary chemists, physicists, geologists, designers and technologists, making their way also into humanities: architecture, history, literature, linguistics. Wide application of computerised devices in production, on transport, in communications, management, science, education and everyday life forms a basic area of the present stage of the STR.

The history of computers is only about four decades old, but the distance between first valve computers and modern super-, mini- and microcomputers is immense. It is hard to visualise how different they may be in terms of their capacity and size. The prototypes of modern computers looked like monsters to those who dealt with them, to be approached with caution. Thus, the first computer developed in 1943 consisted of 18,000 electronic valves and a mass of blocks weighing about 30 tonnes.

Since then a tremendous road has been travelled in developing computers. Take, for example, their speed. Computers of the first generation (and since then four new generations have succeeded each other and that in the lifetime of one human generation) could perform 5,000 operations per second. At that time, the speed seemed fantastic. Transistors and printed-circuit cards that superseded electronic valves raised the figure to 200,000, while in computers of the third generation it soared to 2,000,000.

The present generation, based on microprocessors and large integral circuits, are capable of performing 100 million operations per second. And a fifth generation, which is expected to appear in the early '90s, will be roughly a thousand times more powerful than the present-day computers. And in proportion to their speed, which has grown miraculously, their size has been dwindling apace. From cumbersome room-size wardrobes, they have turned into tiny, palm-size devices.

The heart of a modern computer is its microprocessor. It consists of one or several integral circuits functioning as its central processing unit. Acting on a pre-set programme, it performs all the arithmetic and logical operations with the fed-in data. Physically, it is a flint plate with a built-in electronic circuit composed of dozens or hundreds of thousands of transistors and

housed in a plastic or ceramic case with dozens of outgoing terminals resembling the teeth of a comb.

Today, some 400 types of microprocessors of various rating — up to several million operations per second — are being used in the world, serving different purposes. A microprocessor linked to an external memory and a feed-in and feed-out information device, constitutes a microcomputer, or a personal computer. The software of a personal computer is not very complex and it is just as easy to handle as an ordinary household appliance, some technical knacks being, of course, essential.

At present, the number and quality of computers produced in a country, the extent of computerisation of its national economy, are taken as a basic criterion of its economic and military potential. Three main areas of the numerous uses of computers may be singled out — creation of systems for retrieval and processing of information and development of communication systems for transmitting large information flows; automatic control over intricate processes; and mathematic modelling of objects under study.

Application of computers in designing and in technological provision for production cannot, of course, replace designers, for the machine is devoid of creative abilities. But the computer has already become a reliable assistant of the engi-

neer, who can now make his calculations much faster and can see on the display the graphic picture of the results he wants. Computers help create and develop new plant in a much shorter time compared with conventional practice.

After the designer comes the technologist, who also uses the bank of data stored in the computer's memory: what and how was earlier produced, what materials were used and what methods and hardware applied. This makes it possible for him to take the utmost advantage of the already existing technological solutions.

Wide use of computers has raised a problem of how best to handle them. Today a programmer, i.e., a person who can compose a programme for the machine in its "native" language, acts as an intermediary between computers and their users. But what about engineers and specialists who do not know the fairly complex art of programming? The way out seems to be to "teach" the machine to understand the language in which people themselves communicate. In the USSR information-retrieval systems have been developed and are effectively used to store economic and industrial information. All you have to do is to type a question in your mother tongue, and in 15 seconds the display screen will provide you with the text of the answer.

Research is under way to create machines

which will make it possible to communicate not through typed or printed text, but oral speech. Questions will be put, and answers given, both in a text form and orally. This opens up immense possibilities for using computers in the most diverse areas. Thus, a worker or a foreman would be able to involve himself actively in the production processes controlled by a computer, introducing the necessary correctives, regearing the technology, or just giving a command to rectify diversions.

Intensive work is in process to develop the so-called "artificial intelligence", which term stands for a line of research in which mathematicians, linguists, psychologists, engineers and other experts have pooled their efforts. Intellectronic computers with hardware components of artificial intelligence (i.e., "thinking machines") are today put to most diverse uses to strengthen and accelerate man's intellectual activity.

The so-called expert systems constitute a major area of artificial-intelligence research. In the USSR, for instance, one such system has been developed helping physicians to make more exact diagnoses. Most diverse medical data are fed into the system, generalising the experience of highly qualified specialists, as well as examples of perfectly made diagnoses and of those that failed. Just as in the case of other expert systems, this

one also works in an operator-computer dialogue regime. It not only provides answers to inquiries, but also prepares and feeds out the solutions sought, substantiating them.

Computers are entering into our everyday life. Among them, mention may be made of home (household) computers, which are a simplified version of personal computers, roughly ten times cheaper than the latter and are for non-professional users. Unsophisticated in operation, a household computer is very useful in keeping the house and planning the leisure and working time of family members, storing and feeding out the necessary information, teaching and entertaining, helping its owner to develop his or her abilities, reactions, memory and ingenuity.

It will assist you in preparing and editing copy: set up type, correct misprints, change word order and the format of a printed page, divide the text into paragraphs and pages, preserve all earlier rough copies of your article, insert figures and tables and perform some proof-readers' operations. A household computer is an invaluable aid in organising your home archives, arranging files, selecting bibliography for your degree thesis or an article. It will help you in learning foreign languages and studying other subjects. Uses to which this "unsophisticated" variant of a computer may be put, are practically infinite.

The scale of miniaturising electronic circuits

seems fantastic even today. But specialists believe that it is not the limit, foreseeing the emergence in the near future of "supermicroelectronics" — integral circuits with elements smaller than a micron. Some US scientists expect that roughly by the year 2000 personal mobile robots will be developed.

But many also believe that much earlier, before every person comes into possession of a computer companion, technology based on supermicroelectronics will show what it can do primarily at the factory level. It is possible that superchips will be the key to creating robot-based technological systems capable of seeing, and machines capable of controlling production processes continuously. Even today, minute microcrystals permeate all walks of our life. Development of superchips is believed to be able to change not only the world around us, but our way of life itself.Today, there is talk of "molecular electronics", when elements of microcircuits will be based on just one molecule.

Transition to the molecular level would make it possible to diminish amazingly the size of computers. Minute biocomputers inserted into blood vessels could, for example, closely observe the organism's chemical processes and the state of the vascular system, giving a timely warning of incipient diseases. Replacement of flint-made microcircuits by organic materials would apparently

greatly increase the density of packing information. Films made of "bacteriorodopcine" protein have been developed in the USSR; each molecule of the protein changes colour under the impact of a laser beam. Tens of thousands of books can be recorded on a disc of this film the size of an LP record. A fifth generation of computers is being intensively developed, their main purpose being to provide logical conclusions, imitating man's reasoning and analysing speech and texts. Such machines are sometimes called "thinking" machines capable of formulating a problem, using its description and automatically compiling a programme for its solution.

It is just hard to imagine all possible ways of the development of computer soft- and hardware, but one thing is certain: the near future will witness a rapid rise in the production of the most diverse computers.

2. Robots in the Factory of the Future

Today, automation is a major component of scientific and technological progress, extending to production processes proper, management, designing, computation and, where possible, to research itself. Whereas the industrial revolution was linked with the transition from manual la-

bour to machine industry, the present stage of the STR marks a transition to automated labour in production, a consistent development of automation through improving its content and forms.

Automation has an age-long pre-history of its own. Myths and legends about a mechanical man date back to the hoary past of the kingdom of Sumer and ancient Indian peoples. Let us recall Homer's *Iliad*, where Thetis goes to Hephaestus' copper abode to ask him to forge armour for her son Achilles. The lame God — Smith comes out to welcome her supported by mechanical servants. We know of a good many automatic devices of the ancient world — automatons opening doors in Ancient Egypt or automatic sellers of holy water whose pictures were drawn by Heron of Alexandria. A coin dropped into such an automaton struck a driving mechanism, which opened the valve and the required quantity of water was poured.

In the Middle Ages, automatons were rather widespread using clock mechanisms. Various clocks were created with moving figures of men, animals, etc. Devices also appeared imitating the movements and behaviour of animals. Leonardo da Vinci, for example, invented an automatic lion. In the 18th century, "mechanical men" became widely known — scribes, painters, musicians which have since been called *androizes* after their inventor Henri Droz. But no matter how

ingenious the automatons of the past were, they had never formed the technical basis of society, never changing its production technologies.

It was only in the latter half of our century that conditions had become ripe for a fundamentally new stage in the development of production, leading to the replacement of a mode of production based on machine labour. Automation as such passes through three stages of development, each depending on which of the functions of man are transmitted to machines and equipment.

At the initial stage of partial automation, man's functions of controlling machines are transferred to particular numerically-controlled machine tools and automatic production lines. Achievements of microelectronics and the creation of microprocessors marked a fundamentally new phase in automating production. Instead of former automatic lines oriented on the quantity output of similar goods, there appeared industrial robots and flexible manufacturing systems, that is, machine centres and units capable of regearing themselves promptly to perform different production operations. Thus, they can perform welding and assembly operations, painting and coating, mounting and cargo-handling jobs and all this efficiently, qualitatively and reliably. As an experiment, shops and even whole factories

are being set up where the entire production cycle runs without the participation of man.

The trend towards creating "unmanned" lines of production directly derives from the wider use of robots and flexible automation. It signifies transition to the third, conclusive stage of comprehensive automation, when machines and equipment begin to control production in its entirety, i. e. perform the functions that have previously been exercised exclusively by man. At this stage, production as a whole — from designing to the supply of finished goods — functions automatically. Basically, comprehensive or complete automation is a thing of the future, for today only a trend towards this, the highest stage of automation is emerging. At present, it embraces two main areas: on the one hand, robots and flexible manufacturing systems are being introduced into the production process, and on the other, computerised system of designing and control are increasingly becoming the main agent in the sphere of control.

From characters in science-fiction books, robots have become realities with their sphere of application steadily expanding. The term "robot" coined by the Czech author, Karel Čapek, in his *R. U. R. (Rossum's Universal Robots)* to denote mechanical men created as substitutes for living workers, is now applied to automatons reproducing the movements or the specific features

of the outer behaviour of living beings. It is a machine designed to act purposefully on objects of labour by means of automatic manipulators equipped with sensors of the exterior and automatic devices controlling and planning their operations. Robots relieve man of monotonous and fatiguing manual work. They are indispensable in the extreme conditions where man's presence is undesirable or simply impermissible because of conditions injurious to his health—high or low temperatures, intensive radiation, dustiness, gaseous conditions, in explosion-, flood- and fault-hazardous areas, in water and vacuum on Earth and in outer space. In a comparatively short time, robots have changed substantially in terms of their structure, functions, potentialities, spheres of application and basic elements.

The history of modern robots can be conventionally broken down into generations. The first generation comprises programme-controlled robots designed to perform a specific, strictly preset range of successive operations, servicing specific plant (lathes, forging presses, etc.). Primarily these are mechanical hands (manipulators), their sphere of application being fairly wide. They are used to service numerically controlled machine tools, conveyors, transport facilities, do mounting and assembly work, etc. As a rule, they are not fitted with computers, their control devices op-

erating on the pre-set rigid programmes fed into their memories.

Robots of the second generation represent sensory robots differing from the programme-based robots by a great variety of sensory transmitters, the "sense organs". Their second distinctive feature is that their control systems are more sophisticated, having not only a memory device for the rigid programme of movements, but also a control computer. Such robots can put in order and sort out a medley heap of details, detecting the faulty ones and putting them aside. Modern computers of the second generation are fitted with TV cameras and when a detail comes within the camera's scope of observation, it transmits to the computer all the data concerning it and the camera directs the manipulator actions. A combination of robots of the first and the second generations makes it possible to automate most manual and cargo-handling operations in the various fields of the national economy.

Next comes the third generation — the so-called intellectual or "thinking" robots. They are fundamentally different from the second-generation robots as regards complexity and sophistication of their control system, which includes elements of man-made intelligence. Intellectual robots are designed not only to replace man in performing physical actions, but also and primarily, to automate certain kinds of his men-

tal activity, for example, to distinguish between images and words and make decisions on actions in situations which they have never encountered. A distinctive feature of intellectual robots is their ability to learn, self-educate and adapt themselves in the process of work. Perceiving the objects of the external world by means of its sensory system (a TV camera, for example), the robot forms in the memory of the control system the images of these objects, distinguishes between them, and sends control commands to the manipulator, which takes a specific object corresponding to its image and transfers it to the required place. Basically, intellectual robots exist only as laboratory mock-ups, imitating individual aspects of intellectual activity which, in essence, only remotely resemble man's mental activity.

In many respects, the possibilities of modern robots by far surpass those of man where it concerns working operations. But although robot technology develops rather rapidly, robots still cannot compete with man's intellectual power in terms of analysing situations, self-education, amassing experience, and decision-making. Equally, they are unable to imitate the delicate movements of man's wrist and fingers. The extent to which robot hardware has been developed to date, may be exemplified by a robot recently manufactured by the Japanese firm Toshiba. That robot can independently, without

man's interference, regear and adapt itself to changed production tasks. Specialists regard it as a prototype of a future generation of "intellectual" assembly robots which are capable of not only assessing the conditions of a new problem, but also of compiling a programme for its solution. Structurally, the new type of assembly robot reminds one of the upper part of the human body — it has a torso, two arms and a neck with two videocameras, which give it stereo pictures of the model of the future product. Having man-made intelligence, it can assess the three-dimensional structure of the proposed model, work out the technological chain of assembly operations and perform that programme. Incidentally, first robots of the future generation can assemble mock-up buildings of a pre-set architectural form from blocks of various sizes scattered before them, constantly comparing their work with the assigned model before them.

Clearly, such robots could be applied on any large scale only in the near future. At the present time, less sophisticated robots are used, but the range of their uses is fairly wide, including most diverse operations such as handling, welding, painting, and assembling parts. As robots themselves are improved, that range is steadily expanding. Industrial robots are a powerful lever for raising production efficiency.

The greatest technical and economic effect is

yielded by the group application of industrial robots in robotised technological complexes. In this case, labour productivity rises by two to four times (in some cases, by 5 to 8 times), maintenance costs are reduced and fundamentally new possibilities of the use of comprehensively automated production open up to increase intensity, smoothness, and continuity through working several shifts on end, resulting in better quality and fewer rejects.

In addition to industrial robots, robots are being developed to perform operations previously considered the privilege of man and not connected with production activity (robot translators, chess-players, etc.). The Japanese company Taito recently caused a sensation when it announced it had developed the world's first robot capable of playing a classical guitar. The electronic guitarist is rather corpulent (it weighs over 500 pounds) and is odd in appearance (it has 6 fingers on the right hand and 73 on the left). His odd appearance notwithstanding, the robot guitarist plays as a virtuoso, his repertoire consisting of 50 intricate musical pieces.

Use of flexible manufacturing systems is another characteristic feature of the present stage of development of automation. At this stage, comprehensive automation of production is attained: numerically controlled machine tools, industrial robots and automated systems of con-

trolling production processes are combined to form a single complex. Flexible production makes it possible to pass over to new output in a very short time and with the minimum outlays, using the same plant and merely changing the programmes.

It is quite probable that as it develops, flexible automation would be in a position to make a plant so automated and flexible as to enable it to produce even single items merely in response to command. However, setting up automated factories is an extremely difficult task. Yet, experts believe, it can be accomplished. By and large, flexible manufacturing systems essentially facilitate the process of regearing technologies to meet changed conditions, make for the optimal loading of production capacities and drastically decrease the asset intensity of production.

Being a most important, general and promising trend and a strategic direction of the development of the productive forces, flexible automation, which has been predominant in the mechanical treatment of products by cutting, is today increasingly spreading to the processes of designing, structural and technological preparation of production, as well as to the processes of thermal treatment, welding, assembly, painting and sheathing in various machine- and instrument-building industries.

As we see, automation is the main trend of scientific and technological progress, paving the way to all other trends which cannot make headway unless flexible patterns of automation are advanced.

3. Energy of All Elements

Energy is a sine qua non of the development of human civilisation. Solution of ever new problems in the multiform spheres of man's activity greatly depends on the growing use of energy in the world at large. Power supply is central to the planet's technological and economic problems. Efforts to appropriate sources of energy largely determine world politics. More, it was the possession of enormous reserves of oil that enabled a number of countries to increase substantially their national incomes and solve quite a few problems of industrial development.

The energy crisis that shook the capitalist world in the early half of the 70s, the sporadic rises of prices of oil, sometimes more than tenfold, have led to the growing realisation that energy plays a tremendous role in modern society, giving birth to numerous ideological speculations, including talk of total doom due to the growing fuel hunger. The technical problem

of the short supply of certain kinds of fuel is often considered an international political issue.

And this is not at all fortuitous, for although the acute energy problem is often exaggerated for political or other reasons (the reserves of traditional fuels — oil, coal, and gas — will suffice for the next 100-150 years even in the conditions of the STR), the fact remains that these are nonrenewable sources of energy that will at some time be exhausted. It is precisely because of this that man strives to acquire inexhaustible sources of energy. Most scholars consider that use of nuclear fuel based on thermonuclear fusion would practically solve the problem of power resources. But it would be only natural if we looked into the future: what has the 21st century in store for the human race? Although "energy starvation" does not threaten mankind in the foreseeable future, the world power supply as it is today and will be tomorrow, confronts us with a number of complex problems requiring prompt and practical solutions.

According to scientific estimates, the world requirements in energy in the near future will continue to grow. This is due, among other things, to the continued growth of the world population and the need to use energy more extensively to provide decent living standards for the populations of developing countries. Greater energy consumption in developed and developing coun-

tries will proceed at varying rates. It is expected that annual requirements in energy at a level from 6 to 8 times higher than at present, will become stable only by the end of the next century.

In its time, coal constituted the energy basis for the industrial revolution. As far back as the early 20th century, hard coal was the staple commercial fuel, accounting in 1890 for 96.5% of world output. The energy basis of the present-day scientific and technological revolution is formed by oil and gas, which account for about two-thirds of total energy consumption. These traditional sources of energy are, however, far from being ideal. First, their extraction is very costly, and the costs tend to rise. Secondly, they are much more valuable and profitable if used for chemical processing. It was Dmitri Mendeleyev, the great Russian chemist, who used to say that to burn oil is just as stupid as to fire a stove with money bills. Lastly, there is another, third side to the problem: the traditional burning of mineral fuels (annually some 10 billion tonnes of fuels are extracted) gravely pollutes the atmosphere. Thus, the concentration of carbon dioxide in the Earth's atmosphere is approaching its critical level. It is easy to see what a plight mankind will find itself in by the close of this century, when the output of mineral fuels may double, as some specialists believe, with no steps taken to safeguard the environment against pollution.

The ecological contamination of the planet and the growing costs of extraction of traditional minerals demand that a new approach be sought with respect to man's relations with Nature, as well as new technical and technological solutions of the energy problem. Achievements in science and technology lead to fundamentally new sources of energy being opened up, to better means of its transmission and new scientific and engineering solutions for its production.

Thus, an ever greater share of electricity is produced at nuclear power stations, and forecasts predict that in the near future their output may equal that at hydroelectric stations. And most important, in the nuclear power industry there is no such problem as transporting primary energy-carriers. As is known, one kilogramme of nuclear fuel is equivalent to over 2,500,000 kilogrammes of coal. Properly prepared, the former may be stored infinitely in infinitesimally small warehouses. A continuously operating nuclear power station consumes some 30 tonnes of slightly enriched uranium in one year, whereas a thermal power station of the same capacity would use yearly up to 2,500,000 tonnes of hard coals.

But, as forecasts reveal, the world reserves of cheap uranium — the food of nuclear power stations — may also be exhausted, and in the not too distant future. The point is that thermal reac-

tors — the first models used in the nuclear power industry — utilise only a negligible part of energy contained in the uranium fuel. For that reason, there is search for more advanced and promising technologies, e. g., breeder reactors on fast neutrons and thermonuclear reactors. These would provide for ample energy supply and, consequently, terminate the use of oil and its products (and later, of gas and coal) as fuels, making them available as most valuable raw materials for the chemical industry. Understandably, a host of problems, including formidable engineering problems, arise along the road. Scientists and engineers will have to overcome many difficulties which are even greater than those they encountered in setting up the first nuclear power stations.

Great hopes have until recently been pinned on renewable sources of energy, which were considered to be practically unlimited and ecologically pure. The task began to be tackled of directly transforming the energy of wind, the sun, tide and ebb, and geothermal sources of energy into electric energy. Many countries have prepared special programmes for swiftly tapping renewable sources of energy. But further research has shown that power supply schemes based on those sources were too expensive compared with coal, natural gas, and nuclear power. What role renewable sources of energy will play in the future is not yet clear. However, one thing is cer-

tain: according to various estimates, their share in world power supply will not exceed 15-25 per cent.

Losses incurred in the production and transmission of energy are still too great. Thus, in the generation of electricity up to 75 per cent of the energy contained in primary energy-carriers is lost. In particular, economic efficiency is rather low in modern power units transforming thermal energy into mechanical, and then, into electric power. Losses are quite significant in transmitting energy, as well as in power-consuming units and appliances. The problem is made still more complicated by the circumstance that the structure of the consumption of power changes in favour of those types which themselves require increasing amounts of primary energy for production or transmission.

For that reason, in placing great stress on ensuring the best ways of saving power resources, scientists centre their attention on providing technical solutions to that problem. It primarily concerns a radical improvement in the technology of generating electric power and the raising of the operational and economical effect of long-distance electric transmission lines. This can be achieved only through the STR. Thus, development and use of magnetodynamic generators capable of transforming thermal energy directly into electric, is a new and very promising method

of raising considerably the coefficient of utilisation of electric power. In this way, it would be possible in the foreseeable future to produce the same amount of electricity with half the normal amount of power resources.

In a nutshell, the energy problem may be effectively resolved by applying the following measures: large-scale use of nuclear power, intensifying the production of coal and slate, development of new oil and gas deposits, including those on the continental shelf; intensive use of solar and geothermal energy and the energy of rivers, wind and oceans; rational use of fuels, introduction of energy-saving plant and technologies in industry, farming, transport, economical use of energy in everyday life. One more area should be indicated which promises to free society from the anxieties connected with the energy hunger. We mean projects under way in the USSR, the USA and a number of other countries to master the energy of thermonuclear fusion. This is a formidable task entailing hard and persistent work, but its accomplishment would provide human civilisation with practically unlimited sources of energy.

What remains to be said is the following: discussion of energy problems, the use of nuclear energy in particular, should necessarily return us to the lessons of what happened on April 26, 1986 at the Chernobyl nuclear power station

near Kiev (the USSR). On that day disaster struck the fourth unit of that station. Part of the active zone of the reactor was destroyed, and particles of nuclear fission escaped outside the confines of the station. The station's site and the nearby area of some 1,000 square kilometres were contaminated by radioactivity. The resultant atmospheric radioactivity raised to a certain extent the natural radiation level in some regions of the USSR, Poland, Romania and the Scandinavian countries. The steps taken localised in a short time the effects of the accident and overcame its consequences, safeguarding against disaster striking tens of thousands of Soviet people who inhabited the thirty-kilometre zone around the station.

The Chernobyl accident legitimately raises the question: is it not, perhaps, necessary to stop developing the nuclear power industry which is fraught with such formidable and hazardous consequences? Such concern is quite justified and is dictated by man's striving to find safer ways of satisfying his vital needs. But the world scientific community thinks differently: the future of civilisation is inconceivable without the peaceful uses of nuclear energy. There is no doubt that large-scale development of the nuclear power industry poses serious problems of safety and reliability of the respective plant, demanding the highest of levels of discipline, order and organisation. At the

same time, normally functioning nuclear power stations are not only economically more profitable compared with the thermal, and not only are they ecologically pure. As a most powerful source of energy, they simultaneously prepare the ground for new breakthroughs in technology.

This is the guiding principle for socialist countries, which continue to expand their nuclear power industry. Thus, a nuclear power station called Juragua is being built near Cienfuegos in Cuba's southern maritime province. It will be equipped with Soviet-made plant. The launching of its first section and its link-up with Cuba's unified power grid will save Cuba annually some 2,000,000 tonnes of oil. After the Chernobyl accident, concern was expressed in the USA about the construction of that station. Replying to a letter from a US Congressman, Fidel Castro stressed that not one of the neighbouring countries should feel concern on that score, for the standards of construction and the level of training of the servicing personnel guarantee full safety. The station's design securely protects it even against such highly improbable incidents as an aircraft's crash on its site, earthquakes or underwater slides, which are very rare occurrences in this region. It is built on a monolithic block of concrete of special grades, its reactors will be protected hermetically by thick concrete cupolas,

with all precautions taken against radioactive elements escaping into the air.

Thus, the problem can and must be solved not through discontinuing the development of the nuclear power industry, but by enhancing the reliability and safety of the installed plant. And this applies not only to nuclear power engineering. We must not lose sight of the fact that technology is created by man and is called upon to serve him. In the long run, technological progress is oriented on man. And for this reason, the problem of security and safety in our technical age is primarily the problem of man, who stands to benefit from the STR. It is precisely on man's educational and cultural standards, discipline and proficiency that the flawless, smooth, and safe operation of plant, no matter how sophisticated it may be, depends.

4. Back to the "Stone Age"?

In the years immediately ahead, scientific and technological progress will be spurred on not only by the achievements in electronics, computer soft- and hardware, automation and in the power industry, but also by the advances in the science of materials, i. e., by the creation of new materials and technologies of their production and processing.

Bringing ever new natural materials within the

orbit of technical application has always been characteristic of the scientific and technological revolution. Thus, prior to the 18th century, man used only 19 chemical elements, in the 18th century, 28, in the 19th century, 50, and in the early 20th century, over 60. The STR brings about a situation where all chemical elements without exception may find their technical application.

Or take another example. In the early 20 century industry used only 17 metals. Today this figure has more than trebled. Of special significance for scientific and technological progress are aluminium, titanium, vanadium, and heat-resistant, hard-facing, refractory and wear-and-tear-proof alloys indispensable in modern engineering. To meet the needs of the aerospace industry, medicine, agriculture and other industries, specialists are developing new, often exotic substances. Some resemble in their appearance glass, but they can bind like bandages objects of any configuration. Others can change their form miraculously. Still others look like ceramics, but are extraordinarily durable and resilient. These and similar materials until recently have been laboratory samples, but today they pave their way to widespread uses.

Research and development in the field of new materials is sometimes called the "key to the engineering of the future". Thus, metals that have for a long time been basic construction materials

in building machines and other mechanisms, are now giving way to non-metalic materials: plastics, resins, fibres, and ceramics. Today the latter materials already account for about 20 per cent of the entire "assortment" used by car-makers. True, ceramics of today are quite different from the ceramics man used ages ago to make pottery and roof tiles. Modern technology implies by ceramics all durable inorganic non-metalic materials that could be treated at high temperatures. These are materials with absolutely new properties capable of being used in the thermally intensive parts of machines—combustion engines, turbines, etc. Not all the problems concerned with the widespread introduction of ceramics in industry have been solved, but specialists believe that their full-fledged industrial application may have a revolutionary impact on civilisation, one comparable to the impact microelectronics once registered. The Japanese firm Kyosera, which is a leading firm in industrial ceramics, is producing fancy knives and scissors made of ceramics in packages advertising the birth of a "new stone age".

The range of uses of ceramics is very wide—from artificial teeth to electronic elements. It is applied in nuclear-power equipment and thermonuclear-fusion units, in heat exchangers and gas catalyzers. This fragile material cuts through steel, prolongs the life-service of ball bearings,

engines and gas turbines, making their performance faster and more economical. Use of bioceramics is even more promising. To cite just one example: implanted into the human jaw, it is not repelled by the organism.

New metallic materials used in industry should possess properties making them qualitatively different from the traditional materials and alloys in terms of their purity, chemical composition and physical properties. Fundamentally new technologies are being widely applied for developing such metallic materials and alloys, one being progressive powder metallurgy, which radically changes established patterns in the iron and steel industry and in mechanical engineering. Smelting, casting and metal-cutting are replaced by automatic processes of shaping, pressing, and baking products. You do not have to work a part on a lathe. Often no mechanical treatment as such is needed: a strictly applied amount of powder of the required composition is simply placed into a cast, then with one stroke of the press the part is ready. Losses of raw materials are minimized, precision and quality of parts are superb, labour consumption and the number of working operations are reduced.

To receive superpure and state-of-the-art materials, a number of new technologies have been recently developed, including the application of the process of burning to produce refractory

compounds. A self-spreading high-temperature synthesis is used on an ever increasing scale, to the development of which Soviet scientists have made a great contribution enabling them to produce over 300 composites.

The great opportunities opened up by new materials and technologies, an accelerated development of polymers, in particular, their higher standards and wider assortment, enabled Academician Vasily Korshak, who was a leading Soviet researcher in the science of polymers, to make the following vivid comparison: "As it developed, mankind has passed through the Stone, Bronze and Iron Ages and is now entering the Age of Polymers, which brings it nearer to its Golden Age." Specialists believe that between 1985 and 2000 the world's output of polymers will double, while the growth rate of the output of basic metals in the same period will decline by 50 per cent.

And, indeed, it is hardly possible to list all the fields in which polymers "specialise". Just one example. The whining siren of an ambulance... The condition of the injured man is extremely grave, almost hopeless... How can polymers help here? It is thanks to them that the injured man leaves the clinic a healthy man — surgeons not only saved his life, but made him an able-bodied person again. The broken and smashed bones were fastened by plastic joint-pins, glued

together with polymeric gum, and bandaged with a synthetic tape. These all contained medicines which gradually penetrated into the injured man's body. In the process of healing, joint-pins, tapes and the gum are dissolved and discharged from the body as waste matter. Such treatment has become a regular medical practice of using new polymeric materials with pre-set medicinal healing properties. Quite a few progressive technologies have been developed and are widely used to produce ever new polymeric materials and plastics.

Composite materials produced with special technologies and representing combinations of metals and polymers or metals and ceramics, are today applied on a rather large scale in engineering and industry. Often they are reinforced with wires, threads, fibres and additional special substances. Composites are much superior to the original materials from which they are made in terms of their solidity and hardiness.

Production and processing of most new materials are not based on traditional mechanical treatment, but on fundamentally new, non-mechanical technologies using forms of the motion of matter at intermolecular, molecular, atomic or subatomic levels. In addition to the customary methods of treatment — smelting, casting, rolling, forging, cutting, drilling — perfectly new methods of treatment in extreme conditions are

employed, such as treatment at superhigh and superfast heating or at superlow temperatures.

New technologies virtually work miracles. Thus, the laser is capable of cutting, fusing and hardening surfaces of a part of any configuration. Powder of required composition may be sprayed over and fused onto a used surface. This made it possible to work out technologies of restoring, by means of plasma spraying, the worn-out parts of machines and mechanisms. The technologist now employs not only mechanical methods of treatment, but also those of thermal, chemical-thermal, electric and magnetic treatment, using powerful and pulsating magnetic fields, applying heavy electric current to machine parts, taking advantage of other latest achievements of science and engineering.

New kinds of materials constitute a major component of scientific and technological progress, for they pave the way to new technologies. Thus, the electronic industry would not have reached its present level, had not technologies based on high-purity materials been developed. A chain — technology-new materials-new technologies — is thus formed, having a great impact on the rates of scientific progress. The latest methods of treating and creating new materials which now form part and parcel of fundamental and industrial research, make for higher stand-

ards of labour, efficiency and precision that were unthinkable yesterday, calling for a strict technological discipline indispensable for automated technological processes.

5. Is Air or Iron Edible?

This question may seem absolutely absurd and offensive to a hungry man. But let us not hasten in answering it. The STR changes our life so drastically that what seemed yesterday nonsensical and perfectly improbable, today becomes a regular occurrence. Biotechnology holds a special place amongst other areas of scientific and technological progress: its achievements have not only a great economic, but also a tremendous social impact, being directly responsible for the satisfaction of man's requirements and needs.

Use of biological agents and processes for production purposes has long been known. The term "biotechnology" was coined as far back as the beginning of our century, denoting such ancient spheres of man's activities as bread-baking, cheese-making, wine-making, siloing, etc. As science probed into the secrets of the structure of cells and gained control over cellular processes (even if in the simplest of systems), biotechnology

made tremendous headway, becoming a powerful industry.

Scientists have learned how to create man-made cells with desirable characteristics for microbiological synthesis, staging successful experiments to fuse the cells of higher organisms and produce new cellular hybrids. They have discovered conditions essential for breeding plant, animal and even human cells outside the organism, using artificial media. More than that, methods have been developed to restructure the genetic apparatus, create artificial genes and introduce them back into the cell. As a result, hundreds of new infinitesimal organisms have been produced hitherto unknown in Nature, but having characteristics essential to man.

Modern biotechnology is based on the achievements of biochemistry, microbiology, molecular biology and genetics, which includes genetic and cellular engineering. Progress of these sciences renders it possible both to perfect natural processes and to create processes and organisms non-existent in Nature, but producing substances useful to man. In so doing, biotechnology deals with living organisms and biological processes generally, the "living factories" operating with unheard-of productivity and ecological purity.

Alongside mechanical and power engineering, electronics and chemistry, biotechnology has advanced to leading positions in world scientific

and technological progress. According to estimates world biotechnological output, particularly in agriculture and medicine, by the mid-90s, will be worth 130-150 billion roubles. In many countries it develops at rates faster than those of electronics.

Its origin dates back to the time when scientists discovered that the functioning of such a complex structure as a cell is governed, in the final analysis by the regular laws of chemistry. Figuratively speaking, a cell represents a miniature chemical factory operating with colossal productivity, perfectly co-ordinated smoothness and according to a pre-set programme. Every minute, hundreds of the most complex combinations are synthesized in it, the "wastes" being fully utilised to meet the requirements of growth and development. Today, cells with needed characteristics and even fundamentally new cellular hybrids are being produced in laboratories.

Thus, scientists can now combine the genes of species that have no relations of affinity, producing thereby essentially new plants. Roughly, the method is as follows: after a gene determining some desirable characteristic, such as immunity against a certain disease, has been separated, it is transplanted into the "host plant". New cultures are thus created possessing hardiness against soil salinity and droughts. The barrier of incompatibility can also be overcome in the same way—

hybrids of potatoes, of apples and cherries have already been produced.

Biotechnological processes comprise production of forage proteins, enzyme preparations, biologically active substances and other technologies, as well as the creation of biological systems to transform solar energy. Biotechnology is indispensable in setting up water-purification works. Biotechnological methods are being developed to extract metals from poor ores, sea water and sewage, to augment the productivity of oil layers and produce fuels. We already know of organisms capable of accumulating uranium and lead, and it is quite probable that microbiological methods will be discovered to extract gold and silver.

Limited natural deposits of oil and gas have induced many countries to apply bioconversion to produce alcohol to be used as fuel. Thus, Brazil is planning to cover by the year 2000 three-quarters of its requirements in liquid fuel with alcohol produced biotechnologically from sugar cane. Generation of biogas on the basis of the biotechnological treatment of wastes is also widely used. In addition to biogas, mainly methane, organic fertilizers are produced in this way. Industrial units to produce biogas have been developed and launched in many countries. Traditional production of many useful substances and compounds is gradually replaced by biotechnological processes.

Biotechnology influences in a revolutionary way the solution of practical problems facing medicine and farming. A conclusive stage of medical testing of the universal anti-virus agent — human interferon — is nearing completion. The interferon you buy in drugstores is made from the leucocytes of the donors' blood, which is why it is in very short supply. But a litre of the specially bred microbic culture serving as a living factory producing interferon, puts out nearly five thousand times more of that medicine then a litre of human blood. Development of a technology to produce insulin is also nearing completion. Formerly, animal insulin was used causing in many people strong allergies. A human strain of insulin was needed. Plans were made to produce it through chemical synthesis, but the project proved to be too costly. Scientists turned to bacteria and cells and succeeded in producing a relatively cheap, but just as effective product.

Biotechnological methods help produce vaccines against such infections as hepatitis, malaria, tick-borne encephalitis. Fantastic prospects are opened up by a new and successfully developing trend in medicine connected with the production of biohybrid organs composed of living animal cells packaged in membranes of polymeric plastics. This makes it possible to construct original prosthetic organs based on biotechnology and responding to brain signals transmitted through

the remaining part of the amputated organ. Of great significance is genetic therapeutics, which helps to cure many formerly incurable diseases. Scientists expect that by the year 2000 they will be able to compile a complete chart of human genes.

The present stage of scientific and technological progress is characterised by considerable successes scored in cognising animate nature and in applying the achieved results. Thus, it is quite probable that micro-organisms will be created capable of transforming any substances — metals, minerals or plastics — into food proteins. It has become possible even today to have from 15 to 20 calves from one élite cow in one calving season, transplanting artificial embryos to non-pedigree cows. Scientists believe that soon all selection and breeding in animal husbandry will be based on the achievements of biotechnology.

And what has the biotechnology of tomorrow in store for us? What unprecedented food products will it yield? What heat-, drought- and frost-hardy plants will it evolve? Scholars consider that the time is not far off when animals and plants will be "projected" in line with the needed requirements. It will be possible to "programme" pigs to produce more lean meat, and cows to yield milk with specific properties. Encouraging results have been attained in creating new varieties of plants hardy to unfavourable

conditions, various diseases, droughts, and capable of self-fertalisation by absorbing nitrogen from the air, of scaring away pests, etc. For example, a variety of potatoes has recently been developed in the USA whose leaves contain a natural element repelling pests. A hormone of growth is being used today, making it possible to increase milk yields per cow by up to 40 per cent.

So there is nothing fantastic in African arid deserts being transformed in the near future into fields of wheat that practically does not need water for growth; in plants bearing both tomatoes and potatoes and trees from which you can gather both apples and cherries; in pigs weighing over 1,000 pounds and producing palatable and lean meat. Just as there is nothing fantastic in superproductive cows yielding milk with lower or higher butter content and in the bank of biological artificial organs ready to replace the lost ones... It is most likely then, that the question opening this chapter will pretty soon be answered in the affirmative.

Chapter Three

THE "GREAT REVOLUTIONARY" OF THE 20th CENTURY

The growing significance of electronics, computerisation, computer and information processes at the present stage of the STR has given rise to, and is now breeding in the West, quite a few concepts, which hyperbolically exaggerate that significance predicting that the future of human civilisation almost exclusively depends on the development of the most advanced branches of science and engineering. As a rule, the social consequences of the development of the more dynamic components of the present-day STR are chosen as the main points for consideration. Many scholars regard the computer as the symbol and the materialisation of scientific and technological progress.

Widely current in the West are such exaggerations as a "microelectronic revolution", a "computer revolution", a "technetronic era", an "information revolution" and the like. Modest and inconspicuous, steadily dwindling in size, the present-day computer is presented as the greatest initiator of all these "revolutions", as the "great revolutionary" of the 20th century that has left an ineffaceable and many-faceted imprint on all walks of life and has had a tremendous impact on social processes under way in the human race.

What then is actually happening to society under the powerful impact of electronics, computers, and information flows? Essentially, these changes have more than one implication. However, they are occurring on such a large scale as to justify the rise of most diverse and sometimes too ambitious hypothesis about the future trends of development of society under the impact of science-intensive technologies. As long as electronic technology was just making its way and was largely used to solve strictly scientific or general national problems (fundamental research, outer space, defence) and its impact on the economy was just beginning to tell, Western analysts dealt either with some aspects of information processes or with the socio-psychological aftermaths of the new mass media. Later on, their attention focussed also on general socio-economic, political

and ideological changes in society. But never have their analyses failed to assume the form of ideological struggle between the two social and political systems — capitalism and socialism — the aim being to publicise the technical and economic restructuring now under way in capitalist countries, i. e., to whitewash capitalism.

Let us now consider some concepts and hypotheses dealing with the main aspects of these "revolutions".

1. What Is to Replace the Gutenberg Galaxy?

The Canadian sociologist, Marshall McLuhan, whose works are very popular with the Western public, declared in an emphatically prothetic key (for which the bourgeois mass media have not missed to call him the "prophet of the electronic age") that social development is determined not by the growth of the productive forces or the changing forms of ownership, not by class struggle, but by those means of communication which form the basis of people's interrelations.[1] McLuhan believes that communication,

[1] See: Marshall McLuhan, *The Gutenberg Galaxy. The Making of Typographic Man*, Toronto, 1962.

that is, the process in the course of which joint activity and mutual understanding of people are established, governs all sides of society's life: its economics, political and social structure, and culture. As to his concept of means of communication, which McLuhan views very broadly, he implies by them papyrus and aviation, money and telephone, roads and books. From his point of view, the history of civilisation is first of all the history of the origin and development of constantly improving means of mass communication.

McLuhan calls the historical period preceding civilisation the period of mankind's childhood, the era of a tribal society, which was superseded by the era of the written language marking humanity's youth and a millennium-long predominance of phonetic writing. Likewise, the invention made by Gutenberg in the mid-15th century marked the beginning of the era of the printing press, that is, the predominance of the printing technique based on phonetic writing. Lastly, with the appearance of television, mankind entered the era of electronic civilisation. McLuhan calls this modern stage of development of civilisation a "third youth" of humanity.

As we see, the fountain-heads of development are, for the Canadian sociologist, papyrus, the printing-press, and the television. Thus, he deduces all social phenomena of modern history from

the fact that book-printing arose, giving birth, in his view, to nationalism and leading to the creation of a system of states in Europe. Furthermore, McLuhan believes that all aspects of mechanical culture in the West took shape under the impact of book-printing. As to racial discrimination, estrangement, social apathy and other seamy sides of capitalism, McLuhan attributes them to the latest electronic means of communication.

But what then is the role of man in historical development? Answering this question, McLuhan reveals great concern for man, his faculties and psychological traits. But he views man too narrowly and one-sidedly, as a kind of appendage to machines and equipment. Taken by themselves, means of communication are unable to exercise influence on social processes. Their power to transform things is released only when they are linked up with an individual's sense organs. All man-made means of communication are, then, just "extensions" of man, each of which not only intensifies or amplifies the functions of man's particular sense organ, but also transforms the world man lives in. In this way, McLuhan believes, man is no more than a vehicle of harmonised perception. The moment that harmony is upset, the emphasis shifts to the organs of hearing, sight or touch and technical devices are thus enabled to heed, and respond to, these anthropological shifts and decisively transform all spiritual processes.

According to McLuhan, it is only changes in the means of communication that are responsible for the actual movement of history, dispensing with social revolutions, which are alleged to be of no significance for man's life, entailing no changes of any substance. Exchange of information, powerful floods of volatile images would result in the two socio-political systems converging and finally merging into a sort of tribal community. McLuhan asserts that accumulating changes in culture and an imminent "communicative explosion" will soon relieve man in contemporary bourgeois society of torturous stresses that today poison his life.

For the Canadian sociologist, the "Electronic Galaxy", i. e., television which supersedes the "Gutenberg Galaxy", i. e., the book culture, symbolises the transformation of the world into one large village, the rebirth of the patrimonial tribal community having nothing in common with the pre-television Western civilisation. In this new "global village" created by television, man would submerge into an illusory world, ceasing to perceive the reality of space and time, as well as the morbid tensions habitual for "pre-tribal" everyday life. But to enter this world of dreams is not so simple, for the passage to it is full of latent collisions. In McLuhan's view, this is exactly the reason why mental disorders are so rife today and drug addiction is on the upgrade.

People turn to drugs to "mitigate" their passage from one culture to the other, alleviating their "involvement" into the electronic culture.

Thus as we see, McLuhan's basic ideological aim is to demonstrate that the contemporary revolution in mass communication media leads to the rise of a fundamentally new culture in industrial societies, erasing fully the differences between capitalism and socialism. In other words, McLuhan's concept is just a variety of the bourgeois theory of convergence expounded by the Canadian sociologist in terms of mass information processes. Problems of the communication media, their place in the system of elements of the social structure and growing role in shaping social relations undoubtedly deserve a comprehensive analysis. But the weakness and deficiency of McLuhan's theoretical postulates lies in their starting point — in alleging that technological innovations in communication have a global impact, decisively influencing the entire progress of civilisation.

2. Blisses of Technetronic Idyll

McLuhan's "electronic prophecies", which evoked widespread repercussions in the West, have been used by the US analyst, Zbigniew

Brzezinski who has based his doctrine on the McLuhan's communicative theory. It is the latest means of communication, in the first instance television that create, in Brzezinski's view, a new, supercapitalistic civilisation. He thus comes forward as an oracle prophesying the onset of a new, "technetronic era". "Today," he writes, "the most industrially advanced countries (in the first instance, the United States) are beginning to emerge from the industrial stage of their development. They are entering an age in which technology and especially electronics — hence my neologism 'technetronic' — are increasingly becoming the principal determinants of social change, altering the mores, the social structure, the values, and the global outlook of society." [1]

Brzezinski consistently developed a technocratic Utopia, that is, a set of illusions and expectations foreseeing a beneficial effect from the development of technology. He tried to prove that social antagonisms of bourgeois society could be eliminated without social revolutions, through technical progress alone, regarding all social problems as purely technical. The incipient "technetronic society" is alleged to be a fundamentally new stage of development of human civilisation, where political struggle and social conflicts be-

[1] Zbigniew Brzezinski, *Between Two Ages. America's Role in the Technetronic Era*, Penguin Books, Harmondsworth, 1970, p. XIV.

come meaningless and social problems could be readily resolved if approached pragmatically. For traditional problems, he believes, may be fairly simply solved in a technetronic society by applying technical solutions, which makes traditional methods of resolving social conflicts pointless.

Brzezinski asks rhetorically what makes contemporary man suffer. And he answers that question: first and foremost, unbearable physical labour. But robots and computerised systems are capable of taking over all production operations, ruling out workers' straining their muscles. And this, then, makes strikes and workers' economic and political demands, their struggle for their rights, absolutely unnecessary. More than that, labour generally turns from a "must" into a privilege of the elect. What are the other discomforts of contemporary man? These are the unfulfilled yearnings of his soul, his estrangement and loneliness... And here again a technical remedy comes in handy — an electronic match-maker. Possessing an immense store of electronic memory and using the fed-in data on the inclinations, preferences and tastes of a lonely, restless and longing soul, it is capable of finding among millions of the similarily searching souls a kindred soul and helping their reunion.

And what about millions of people suffering from racial discrimination? The remedy offered is

ready-made, pure and simple. To the rescue of Afro-Americans, Puerto Ricans, Indians and all others suffering from ethnic and racial prejudices comes the ointment for depigmentation of the skin. If the black colour of your skin brings you discomfort and sufferings, just apply this ointment and your skin turns white. It, then, transpires that thanks to this magnificent product of cosmetics and pharmaceutics, the nationalities question — one of the most troublesome problems of contemporary bourgeois society — simply ceases to exist. In this way, technical solutions to social problems cut the ground from under the feet of social conflicts and political struggles, for social problems can readily be solved through engineering methods.

But what lies in the path of this forthcoming paradise? Why is it that social contradictions and controversies in capitalist society not only do not vanish, but, on the contrary, grow increasingly sharper? The US political analyst justifies their actual presence and their need as "growing pains", as the contradictory nature of the two technical stages of capitalism's development and the way in which the "technetronic revolution" proceeds, marking a transition from the era of industrialisation to the era of technetronics. On the one hand, Brzezinski says, there exists a "new America" personified by the state-of-the-art enterprises, modern academic institutions and

R & D centres. On the other, this "technetronic America" embodying the "new society" is antagonistically opposed by "industrial" and "pre-industrial" America, which suffers from chronic social disorders characteristic of the "epoch of industrialisation". It is the adherence of the masses to conflicts and problems of yesterday that Brzezinski sees as the main cause of the present stage of the "technetronic revolution", which exacerbates many social derangements, making the transitional period to the kingdom of technetronics torturous and even fatal for a fairly large number of Americans.

Imparting to his theory extremely broad, general sociological significance, Brzezinski attributes all contemporary contradictions and conflicts to the confrontation of "two ages" — the industrial age and the technetronic age. In his opinion, the controversy between the highly developed West headed by the USA, which is entering the technetronic stage, and all the other countries passing through the industrial or pre-industrial stage, expresses the essence of the contemporary epoch. In this way, Brzezinski predicts, humanity faces the alternative: either a global "technetronic world order" or international chaos as a prelude to another world war. The threat of war is thus used by Brzezinski in an attempt to prove the superiority of "technetronic progress".

The idyll of "technetronic society" depicted

by the US analyst is nothing more than a modernised state-monopoly capitalism demonstrating higher economic growth rates and more decisively oriented on space and military programmes.

3. Banishment from Paradise

The concepts of "electronic", "technetronic", "computer" or "information" revolutions are all based on a traditional bourgeois methodology which considers technology to be the only way of solving all human and social problems. The scientific and technological revolution that began in the mid-20th century generated in the West an illusion that technology may save capitalism from its doom, historically determined by the laws governing society's development, and remove contradictions and antagonisms inherent in it. The unprecedented growth of industry, the sharp rise in labour productivity, faster economic growth in large capitalist countries, temporary economic stability, all combined to reinforce these views. It seemed that crises that shook the capitalist world in the late '20s had for ever become a thing of the past. Hopes arose that a crisis-free and endless progress would ensue, ruling out conflicts, depressions and other morbid processes in the life of capitalist society. Hence the rise of technocratic Utopias based on

wishful thinking and illusions about the beneficial impact of technological development on capitalism and used to vindicate it.

The achievements of cybernetics and of information technology, as well as of "intellectual technology" connected with it — systems analysis, mathematical programming and operations analysis — were additional arguments in favour of technocratic illusions. Technocrats pinned their hopes precisely on these new departures in scientific and technological progress, expecting that they would help solve effectively the problems of controlling society's social and economic processes. Moreover, all social processes were considered to be purely technical, and possibilities were sought with the aim of ridding bourgeois society of social antagonisms without a social revolution and through technological progress as such. Information technology came to be regarded as the basis of existence and development of contemporary society. According to Zbigniew Brzezinski: "technetronic society ... is shaped culturally, psychologically, socially, and economically by the impact of technology and electronics — particularly in the area of computers and communications." [1]

Bourgeois researchers make an absolute of technological progress, reducing the productive forces

[1] Z. Brzezinski, *op. cit.*, p. 9.

to machines, equipment and technology, and relations of production — to technical and organisational structures. In so doing, they apply the model of the so-called "technological society" embodied, in their view, in the industrially developed countries of the West. The nature, development and basic characteristics of that society are alleged to be immediately determined by the state of the productive forces. They rule out their link with relations of production. This process, they say, becomes increasingly intensive as science and technology permeate all spheres of life of contemporary society.

Basing themselves on this approach, bourgeois researchers expound a philosophy of history directed against the Marxist teachings about society, substituting stages of industrial development for historical epochs. The leading trend of modern human history they regard as a transition of some countries from the "pre-industrial" and others, from the "industrial" stage of development to the "post-industrial". The latter stage is considered to be either a fundamentally new stage of historical development or the extension of the preceding stage, being its new phase not to be replaced since it embodies all the more essential achievements of social progress.

But the wide introduction of "information technology" has not led to the expected solution of social and economic problems. On the contrary,

it has given rise to new problems and disillusionment. Capitalist economy in the late '60s demonstrated the inadequacy of the technocratic methods of management. A very grave structural crisis in the early '70s was the last straw: it became perfectly clear that conflict-free management of capitalism was out of the question. The exacerbation of the general crisis of capitalism in the late '60s and early '70s gave the lie to the myth that capitalism had entered the period of crisis-free and conflict-free development. "It was fascinating to see," Alvin Toffler wrote concerning the onset of the crisis, "in a little more than a year, how all our long-standing assumptions about affluence, leisure, and unlimited growth could be overthrown. All the rosy expectations of the '50s and '60s, it seemed, were suddenly pushed aside by a growing public dread of what, so recently, had been unimaginable." [1] Man had been banished from the technetronic paradise.

Of major significance for the crash of technocratic illusions were the proceedings of the so-called Club of Rome, an international non-governmental organisation set up in Rome on the initiative of a group of Western scholars. The Club has among its members prominent scientists and outstanding political and public figures

[1] Alvin Toffler, *The Eco-Spasm Report*, Bantam Books, London, New York, Toronto, 1976, p. VII.

from many countries. Analysing the raw-materials and power resources of our planet, members of the Club of Rome have come to the sensational conclusion that these resources are nearing exhaustion. But if that is so, there can be no talk of transforming society on the basis of the achievements of the scientific and technological revolution, for it transpires that technical civilisation has no future. As a result, socially critical views and concerns began to spread like wild fire, culminating in prophecies of a global catastrophe and the world's doom — contemporary apocalypse. The threat of nuclear war and ecological crisis also nourished these moods.

But is the world actually faced with the threat of a raw-materials and energy crisis? Has technical civilisation been robbed of the foundation for its development — the resources? Do we really have to forgo technology and technological progress? Clearly, there are no serious grounds for such conclusions. And members of the Club of Rome themselves later changed their views, stating publicly that their initial assumptions were inaccurate. Humanity has everything necessary for civilisation's progress — science's potential discoveries, technological innovations, and adequate reserves of raw materials.

We should not, however, lose sight of the fact that technology develops in different socio-economic systems. It is not neutral socially. The

type and character of social and economic relations have an impact on its development. Under capitalism, scientific and technological progress has long been at loggerheads with private ownership. For the more amazing the achievements of science and technology, the more catastrophic their use in the conditions of capitalism, which has got stranded in contradictions and antagonisms inherent in it. At the same time, while they justly acknowledge that capitalist society is gripped by a deep crisis, bourgeois writers ignore the impact of the social system on the trends and social consequences of the scientific and technological revolution, extending that crisis to all countries.

4. Myths of the "Information Society"

Beginning with the second half of the '70s, technocratic concepts were increasingly imbued with new ideas connected with the "information revolution", which ushered in a wide application of communication and computer technology in the economic and social spheres. A distinctive feature of the present stage of the STR consists in that it is now possible to retrieve, store, process and transmit massive flows of information with the latest technical means, with incredible rapidity and relatively low outlays. That information

has come to mean much to the world is indisputable. It is estimated that by the close of our century the information flow will increase more than 30-fold.

The network of information communications increasingly asserts itself as the "nerve system" of the whole society. The information factor has caused, in the past few decades of human civilisation, the most profound change history has ever witnessed, uniting the world into a single information system and making information an especially treasured social value. Although knowledge and information have always been highly valued socially, it was only in the 20th century, with its swift rates of social development, that information has turned into a veritably strategic resource of humanity.

In the system of the contemporary productive forces, information and information technology have become a relatively independent and a most dynamic factor of development. The place a particular state holds in the international division of labour, its stature in the world community, is largely determined by the extent to which this resource is available to it. Availability of information resources, just as the availability of food and power resources, becomes a major yardstick in characterising the contemporary stage of mankind's development.

Computerisation of services, the rise of new

mass media and wider application of the traditional ones, the emergence of a specific area of knowledge — informatics (a science of the laws and methods of amassing, processing, and transmitting information) — all this greatly contributed to the invigoration of technocratic Utopias, resulting in the construction of global theoretical models and specific social projects.

New ideological concepts originated with a view to glorifying the bourgeois patterns of scientific and technological progress. The idea of the "information society", a society arising in the wake of the "information revolution", has become a common denominator of these trends. This idea offers a tempting way out of the deadlock of "industrialism", leading to a fundamentally new stage of civilisation, at which all the vices of capitalism will wither away by themselves. Its class purpose is evident — it is just another attempt to demonstrate that capitalism is eternal.

Alvin Toffler and Joneji Masuda were among the Western researchers who lost no time in snatching at the promising ideological and theoretical opportunities offered by the "information-society" concept.

One of the versions of the theory of the "information society" was presented by Toffler in his book *The Third Wave*. Toffler considers history as a succession of sweeping waves, and society's development, as a successive alteration of three

waves of changes, each asserting a new way of life. According to him, the first wave of changes was the agrarian revolution, which began around ten thousand years ago and continued roughly till the end of the 17th century. The second wave, which resulted in the formation of industrial civilisation, lasted for two and a half centuries. The third wave of changes began to surge in the USA in the mid-1950s and somewhat later in other industrialised countries.

The emergent civilisation is largely different from traditional industrial civilisation. It brings in its wake, Toffler believes, a really new way of life based as it is on electronics and computers, space-based production and the use of ocean depths and bio-industry.

Portraying a broad and rather fascinating panorama of changes of various aspects of society's life and playing safe against possible accusations of being technologically tendentious, Toffler repeatedly stresses that technology is not the only determinant of social change. But if we examine his analysis, we are bound to note that all changes in society are presented by him as occurring largely under the direct impact of technical change. At the same time, Toffler often says that technology proper should conform to ecological and social criteria. But then, perhaps, the accusations that he is technologically tendentious, exaggerating the role of technology (doing which he

himself denies) are groundless? Unfortunately, they are not. For in his analysis, social structures as such are not the product of the objective historical process, they do not emerge as a result of the activity of classes, but derive from the particular aspects of the latest manifestations of scientific and technological progress and are made to "fit" them.

Toffler's constructions disregard radical and fundamental differences between the different types of production relations. In the societies of the second wave, i. e. industrial societies, he includes both capitalist and socialist countries. This US scholar makes no distinction between the two opposite social phenomena — capitalism and socialism — alleging that they are quite alike, since they both have similar traits and face similar problems whose source is technological progress.

And although Toffler claims to have opened a "new chapter" in the science of society, a careful perusal of his *The Third Wave* reveals that the model he has evolved is actually based on a premise which was elaborated in bourgeois literature as far back as the 1950s and '60s and which suggests that historical development comprises pre-industrial, industrial and post-industrial societies.As to the crisis through which contemporary capitalism is now passing, the US futurologist tries to attribute it to the "wane of industrial

society" and the difficulties it encounters in the transition to a new civilisation.

In his book *The Information Society as Post-Industrial Society*, a prominent Japanese futurologist, Joneji Masuda, projects the traits of an "information society" in which a state providing for the universal flourishing of human "intellectual creativity" arises in place of a society of excessive "material consumption". He proceeds from the assumption that it is the logic of the stage-by-stage development of information and computer technology that dictates progress in that direction. At first, computers were used to solve scientific problems of a particular country. Then they helped solve the problems of management. And now society as a whole becomes the object of computerisation, the aim being to improve social conditions. The next stage presupposes the solution of problems faced by the individual. At this stage, individuals will be availed of the opportunity to use information just as freely as they use electricity or water, first through national, and then through global information networks. This, in the author's view, would lead to universal affluence. "Globalism" would become the spirit of the times in the "information society". It would be permeated by three ideas: the feeling of the unity of mankind, a non-violent symbiosis of man and Nature and the emergence of a "global information space" knowing neither regional nor

national frontiers. Such, in the nutshell, is this Computer Utopia.

True, the "microelectronic revolution" does exert a powerful impact on modern society. According to estimates, the world trade in goods produced in the electronic industry amounted in 1980 to 100 billion dollars, and by 1990 it will soar to 400 billion dollars. In terms of the cost of its output that industry will thus advance to the position of the world's leading industries ranking immediately next to steel-smelting, car-making and chemicals. The "information sector" of the economy grows at faster rates than others. According to UNESCO sources, today more than half of the entire gainfully employed population in the more developed capitalist countries are engaged directly or indirectly in the production or dissemination of information.

Development of electronic and information technology results, however, in grave social imbalances. Apparently, the social structure of bourgeois society will not tend to integrate itself internally, as the concept of the "information society" proclaims it would, but will witness increasingly deep social and class stratification. The social and economic processes of informationalisation of capitalist countries provide a general background against which the evolution trends of the bourgeois political system take shape: these are the political destabilisation of so-

ciety, undermining of traditional institutions and norms, increasingly "uncontrollable democracy" and the efforts of certain political forces to tighten control over society as the natural response to the above processes.

Nevertheless, the proponents of the "information society" place political problems in a different, technological context, predicting a favourable political future for capitalism on the strength of the development of multiform technical systems. And here it should be stressed that projects of the "information society" are largely based on practical social and engineering research and experiments. Thus, Japan has developed and is already implementing a national, government-sponsored programme "The Information Society". In France, a government commission prepared in 1978 a report entitled "The Informationalisation of Society" which was used to map out national policies in the field of telecommunications. Other West European states have also embarked to varying degrees on similar programmes. As we see, practical steps are being taken to develop the information sector.

But does it mean that a transition is being made to the "information society"? Or is it a long-range prospect? Or, perhaps, the "information society" has already taken shape in contemporary industrially developed countries? Here we must at once say that the answers given

by the various authors of the concept of the "information society" are just as varied. The point is that although there exist rather detailed technical projects for the informational transformation of society, Western sociology still does not have a clear-cut concept of what the "information society" should actually be.

Theoretically, the "information society" is firmly based on the assumption that information is decisive for the present stage of social development. Joneji Masuda notes: "The information epoch to be brought about by computer-communications technology does not mean simply that it will have a big socio-economic effect upon contemporary industrial society; it will demonstrate a force of societal change powerful enough to bring about the transformation of society into a completely new type of human society, which is the information society." [1]

But the question naturally arises: is it right to determine a social entity based upon only one and, what is more, non-material side of society's vital activity? For no matter how great the role of information may be, it cannot by itself change the character of social relations. The sphere of information activity develops in line with the general laws inherent in the given mode of produc-

[1] Joneji Masuda, *The Information Society as Post-Industrial Society*, Washington, 1981, p. 59.

tion. Under capitalism, it is subordinated, first and foremost, to the production of surplus-value. Furthermore, the results of the application of information technology are affected by the specific economic and socio-political conditions of its use. Mammoth corporations and the bourgeois state rule supreme in many branches of the information sector in developed capitalist countries. Just as science and technology, information turns into the object of competition between monopolies to strengthen their positions and into a means of social control and capitalist exploitation.

Although it reflects a number of objective and really significant social and technical processes triggered off by the spread of information and electronic technology, the concept of the "information society" interprets them in a distorted and Utopian way, brushing aside (in most cases, deliberately) the gravest of social problems. The path to the solution of urgent economic, social and political problems does not lie through the automatic transformation of bourgeois society based upon the potentialities of microelectronics, as the proponents of the theory of the "information society" believe. These problems can only be solved through the revolutionary and transforming activity of the people led by the working class. In this connection, it is not so much the technical and futurist projects themselves (which are often rather comprehensive) that deserve crit-

icism. What makes one doubt their validity is the extremely naive remedies and steps recommended to eliminate social antagonisms and solve such intricate and formidable social problems as crime, racial strife, ignorance and cultural backwardness. According to these projects, central to all social transformations is just one "great revolutionary" of the 20th century — the Computer, which almost automatically solves these most complex problems.

True, technology is capable of changing our life substantially. More than that, implementation of individual socio-engineering projects, such as those proposed by the Japanese national government-sponsored programme "The Information Society", demonstrates that technological estimates of the impact of information technology on production, marketing, transport, services, management, medicine, education and everyday life, are correct and there is no need to dispute them. It is more important to point out the radical, methodological miscalculation underlying these Utopias.

The point is that Western sociologists practically completely ignore the subjective factor, the role played in history by classes and social groups, and are guided by the principle of technological determinism. But history is made by human beings, not by technology. Marxism attaches great significance to the productive forces,

seeing in them the basic source of societal progress. But the productive forces cannot be reduced to technology alone, for man is the main productive force of society.

Furthermore, the productive forces are connected with social relations, the political system and the specific social formations generally. For that reason, historical development is not conditioned by technology alone, which itself is subordinate to quite a few economic, political, social, and cultural factors. Social progress increasingly derives from the growing socio-historical activity of the broad mass of the population. The productive forces develop in the framework of definite social relations which do not arise from the former spontaneously, automatically, but are themselves influencing the development of the productive forces. Therefore, it would be wrong to separate the scientific and technological revolution from the social, for they are closely interconnected. A new society cannot be built unless relations of production are changed radically and fundamentally, and private ownership and exploitation of man by man done away with.

Chapter Four

SCIENCE AND TECHNOLOGY VERSUS MAN?

The impetuous flow of time is inevitably taking us closer and closer to the new millennium. Modern thinkers, like the prophets of the Middle Ages who associated the year 1000 with the end of the world, are also trying to forecast in their predictions about the year 2000 and the span of time behind this date, what the future has in store for man and human civilisation. The present stage of the scientific and technological revolution, with its dynamism and ever increasing influence on all the spheres of life, is more and more urgently impelling researchers to direct their attention to the latest tendencies and prospects of deve-

lopment ingenuously linked with scientific and technological progress.

What will happen to mankind in the near future? What does scientific and technological progress have in store for it? Forecasts are most varied. Serious economists, mathematicians, philosophers, sociologists, representatives of other professions are competing with science-fiction writers in describing what awaits man in the forthcoming millennium. Here you can come across effective cures from the diseases of the century — cancer, heart diseases, the plague of the twentieth century — AIDS — as well as caloric, science-based diets, artificial human organs, "electronic" newspapers and videophones; comfortable automated dwellings serving for many people not only as places for recreation, but as work places; new kinds of fast and comfortable transport; completely automated "factories of the future" and many other things, which strike the imagination of modern man.

We do not, however, regard the future as a would-be Utopia. Capitalist society is bringing along deep contradictions and incurable defects into the future millennium, as under capitalism social consequences of the STR are of a complex and contradictory nature. On the one hand, new and improved everyday appliances, conditioners, colour TVsets, videotape recorders and comfortable transport have become more available. Med-

icine has undergone qualitative changes, mechanisation and automation of labour are increasing and, as a result, labour is decreasing, agricultural production is growing. In the course of the first post-war years the workers of the developed capitalist countries managed to achieve higher wages and get some social benefits. This gave them the opportunity to enjoy some new kinds of goods and services.

On the other hand, many tendencies, with all these contradictions of capitalism in mind, arouse anxiety and concern, make one ponder over the future. Science and technology, destined to improve people's life, are employed to perfect new weapons, threatening to annihilate life itself. Hopes to increase labour productivity and make work easier are connected with robots. However, promising as they are, they cause mass unemployment. Behind the facade of wealth and luxury created by the productive forces of society which have infinitely grown under the influence of scientific and technological progress, there lie hidden misery, extreme poverty, lack of elementary living conditions of millions of people. The latest technology helps to commit the "latest" crimes unknown yesterday. The most complicated electronic devices are used for watching and listening and interfering in private liberties in affluent society. Capitalism at times turns the most outstanding achievements of sci-

ence and technology into instruments of cultural degradation and decay. Cinema and television are flooded with programmes glorifying crime and violence and imbued with anti-Soviet, anti-working-class, racist propaganda, as well as tasteless commercials that occupy considerable time in all the programmes. In a word, there is no end of examples of anti-human use of achievements of technological progress perverting the very essence and aims of the development of science and technology, their ability to promote harmonious and accelerated development of human civilisation.

1. Science of the Late 20th Century: Serves Peace or War?

The ever spiralling arms race ranks as the first of the obviously dangerous negative tendencies brought about by the development of the scientific and technological revolution under capitalism. By directing scientific and technological progress into militarist channels, capitalism not only creates moral danger for mankind. It leads to the senseless and unproductive waste of all the resources of civilisation. Plans to bring the arms race into outer space are a flagrant example of the perversion of the humanistic content and es-

sence of scientific and technological progress itself.

Spiralling militarisation becomes a brake on utilising the achievements of the scientific and technological revolution for the benefit of humanity. In the 1970s, in member-countries of the Organisation for Economic Co-operation and Development (OECD) a third and, in the USA and UK, about a half of all the government expenditures on science and technology, were in fact invested in military research. At present, more than 75 per cent of the US federal budget funds for research and development are allotted for military purposes. Since 1980, allocations for military research have been increased by 250 per cent, while on science at large only by 75 per cent. This results in the unproductive use of vast material resources and of the efforts of highly qualified scientific cadres, diverting them from the implementation of urgent socio-economic tasks.

For example, the military aspect is primary at present in the US Energy Department created officially for the purpose of developing alternative sources of energy and devising methods and measures for utilisation of solar energy and power supply, as well as of reducing dependence on oil imports. The draft budget for the 1988 fiscal year provides for the allocation of $11.5 billion to the Energy Department, $8.5 billion of which is

included in the item concerning the use of atomic energy for defensive purposes. At present, only two of every ten dollars allotted to the Department are spent on peaceful purposes, the rest goes for the build-up of the country's nuclear arsenal. Funds are also withdrawn from civil projects to implement plans for outer space militarisation and the strategic defence initiative (SDI). Half of the funds allocated for the creation of dozens of nuclear reactors to be used in outer space are included in the civilian part of the budget, though how they will be used for peaceful purposes is not at all clear.

At present, US civilian production, according to some estimates, is 20 times less science-intensive than the military. This, in turn, results, as the calculations of US experts reveal, in the US losing a year's industrial output every 12-14 years owing to military expenditures. According to those very estimates, the technology of civilian industries could have achieved the standards forecast for the year 2000 by 1980 if technological innovations were employed primarily in civilian and not military production. The disastrous influence of the use of US science for military purposes manifests itself, in particular, in the fact that monopolies of other capitalist countries, which used a comparatively small share of their scientific and technological resources for military purposes, have gained advantages over the US

monopolies. Militarism linked to scientific and technological progress resulted in intensified use of achievements of science in producing weapons of mass destruction. Such unproductive waste of the scientific and technological potential blocks the progress of humanity.

However, perhaps militarisation of science is inevitable and, more than that, necessary under present conditions? Perhaps the progress of humankind would be much slower without it? It is not without reason that a new trend has made its appearance in the West, which unequivocally declares militarisation of science a necessary precondition for its progress in general. "War is the motive force of progress"— this old slogan gained a new, "ennobled", interpretation from the adherents of such an approach. "Armament is a guarantor of peace and progress of science and humanity!"

Arguments in favour of this sound quite attractive and convincing ... but only for those who do not take the trouble to consider their meaning. Scientific investigations for the needs of defence broaden the horizons of science and technology; even if benefit from scientific research in the military sphere is not quick to manifest itself, it still could appear great; a country not involved in military research will become a "second-rate state". Assertions of the kind are made by prominent statesmen, political and military figures,

scientists and political analysts in the West. The reference to the future shift of technology from military to civilian industries, the creation in laboratories of a considerable amount of so-called "dual purpose technology" is the main argument in favour of such an approach. Let's see what is in fact happening. Is civilian benefit from military research so great?

Let's turn, for example, to the development of electronics in the USA — the industry in charge of production of semiconductors, integrated circuits, computers, computerised equipment and telecommunication systems. Electronics is one of the most science-intensive branches of modern industry. According to some estimates, the military-oriented sector of electronics in the USA has considerably surpassed the general level of the industry, leaving it ten years behind. It has thus become practically impossible in many cases to apply results of research and development in military to civilian industries. Under such conditions, the growth of expenditures on the accelerated development of military electronics enforces unfavourable tendencies in industry, and makes the shift of cadres from the civilian sector to the military more intensive.

Intensified development of military electronics reduces the competitive power of the US electronic industry, since the military sector absorbs vast resources. The electronic industry has

a great stake in retaining technical leadership both in household and industrial electronics as it exports approximately a quarter of its output. However lately, its positions in the international market have been considerably weakened and even completely lost with respect to such consumer goods as transistor radios, colour TV sets, audio and video tape recorders so that production of some of these items has ceased in the USA. Losing a particular market, US companies lose additional sources of financing to develop new products or to expand the production of those goods where they still maintain priority.

It cannot be denied, at the same time, that a number of technical innovations that have gained wide use today made their first appearance in the sphere of military research. However, this is a by-product of the process of the intensive waste of accumulated scientific and technological potential for non-productive and anti-humane purposes. According to the estimates of the Star Wars programme made in the spirit of a commercial by one of its "godfathers", Edward Teller, with whom many who support the US military space adventure express solidarity, up to 90 per cent of the results of the programme might be later used for civilian purposes.

Is this true? Research within the framework of the strategic defence initiative is under the seal of

special secrecy. Even those firms that are its subcontractors can only obtain information within the limits of US security. More than that, according to Lewis Branscomb, Vice-President of IBM, the civilian effect of this programme "is likely to be but a trifle", as the superpowerful lasers, particle beams, large-scale optics and infrared sensors are unlikely to find commercial use. And, finally, many Western specialists consider SDI adventuristic in general, as many of the required technological parameters are not realisable not only today, but at the much more advanced level of scientific development than the present.

The general effect of the strategic defence initiative will be obviously opposite to Teller's prognoses. Paralysing scientific and technological resources, SDI will probably slow down the introduction of civilian technology. The Star Wars programme will also place the security apparatus in charge of scientific activities in general, thus resulting in the slower introduction of innovations and distribution of new technology in various non-military branches of the economy. There will be export limitations for security reasons on those innovations that will still find their way to the market. It will finally hold back the growth of the new commodities market, as well as the introduction of new technologies aimed at resolving large-scale economic problems.

According to UN experts, civilian branches of the economy, ensuring 95 per cent of the world GNP, have only 75 per cent of world scientific potential at their disposal, which in itself is a disproportion. Militarisation presupposes that the results of research are kept in secrecy and their dissemination is limited. It is impossible to promote a harmonious and effective development of science when scientists are unable to communicate and exchange information. One of the mainsprings of the progress of science as a global process is thus being destroyed.

Military-technical solutions, if suggested to civilian industries, have at least three negative peculiarities. Firstly, they are meant for a limited number of industries. This approximately makes 60 of the 496 subindustries in the USA, and is naturally far from satisfying the technological needs of the economy in general. Secondly, the latest trends in military research, oriented specifically toward resolving military tasks, are quite often far from civilian needs. And, thirdly, technological solutions of the kind, like military production in general, are on every hand developed with no account taken of their cost, thus making their introduction into civilian industries unprofitable. More than that, intensifying the arms race, the military-industrial complex often permits military products to be put out technologically incomplete. What is new is not the shift of technol-

ogy from the military sphere to the civilian, but vice versa, persistent search for ideas by military research in the civilian. This in the main accounts for the efforts of the USA to employ the scientific and technological potential of its allies, notably Japan, for SDI.

Those circles in Europe which support the idea of EDI — a European Defence Initiative — that originated in the beginning of the 1980s during preparations for the stationing of US cruise missiles and Pershings-II in Western Europe, have similar motives. They are planning to create an anti-ballistic missile (ABM) system in Western Europe against medium- and shorter-range missiles. And, as some circles (military, above all) think, the "Eureka" programme could render considerable assistance in the realisation of EDI. "Eureka" is aimed at coordinating West European scientific research precisely in the civilian sphere, as was many times officially declared. Indeed, five of the ten projects approved at the second conference of the states interested in the implementation of the "Eureka" programme held in Hannover in 1985 can be utilised for military purposes directly. Almost all the new technologies elaborated under the programme have similar direct or indirect potentialities. The question as to whether it will happen in reality has, above all, socio-political colouring. That is why one can

hardly say in earnest that "Eureka" is a purely civilian project.

Thus, the arguments of those who regard armament as a driving force for the progress of science do not stand up to criticism. And, on the contrary, one can say quite safely that under the present conditions of the continued arms race, reactionary circles are intensifying their efforts to turn the science of the end of the twentieth century into a servant of the military-industrial complex. With so many great creative tasks facing humanity, a useless waste of intellectual and material resources is taking place, undermining the very foundations of civilisation.

2. "Unwanted People" in the World of Robots

The feat of losing one's job was never so great in capitalist society as in the 1980s. Indeed, unemployment is one of the most acute contradictions of capitalism. "Future work — will it be ours or the robots'?" One often comes across such headlines in the US press analysing the prospects of employment in the country in the 1990s.

Why the anxiety and uncertainty? The scientific and technological revolution in the capitalist world ultimately leads to the growth of unem-

ployment. According to official data, the total number of unemployed in the twenty-four advanced capitalist countries who are members of the Organisation for Economic Co-operation and Development was 40 million at the beginning of 1986. That army of "unwanted people" exceeded in number the combined populations of the Netherlands, Belgium, Denmark and Switzerland. If all those who work a shorter week and those who, losing any hopes of finding a job, are no longer registered as unemployed, are also taken into account, then there are 20 million unemployed in the USA alone.

The level of unemployment resulting in particular from computerisation and robotisation of production and management has reached unbelievable heights. It is estimated that the number of computers and reading machines will increase two-fold in the FRG by the end of the 1980s, and the number of industrial robots, five-fold, to as many as 30,000. Moreover, by 1990 there will be 100,000 robots and 20 million computers in the USA. All this will result in the elimination of one million jobs in US industry by 1990 and from 2 million to 3.5 million jobs are forecast to disappear in the FRG. According to researchers from the Carnegie-Mellon University, robots can carry out 7 million kinds of work procedures—none third of all the work in US industry. In the future, according to forecasts, 65-75 per cent of

all jobs in US industrial enterprises may be automated.

Are we overestimating the dramatic nature of the situation in recalling that automation under capitalism always resulted in mass dismissal of workers? And what if the improvement of the economic situation and a new economic upsurge will result in an equally quick rise in employment? Unfortunately, we are not dramatising the situation. There will be no rise. What has changed the situation at present? Why do those processes and mechanisms that once used to prevent the situation from becoming so tense, stop operating?

The main goal of technological development has at all times been the increase in the productivity of labour and efficiency of production in particular branches of the economy. But the local and protracted character of these processes gave the labour force that was released as a result of this, the chance to be shifted to other industries and to the services sector as well, which was steadily growing during the whole post-war period. And although this caused the loss of qualifications and acquired rights and privileges and led to the worsening of the position of the working class in general, still the situation, after periods of aggravation, tended to become less tense.

The technological reconstruction on the basis of wider introduction of the latest achievements

of the scientific-technological revolution results in considerable changes in the sphere of employment. Unlike automation and computerisation of the 1960s, the range of application of electronic machinery has sharply widened today. Computerisation and introduction of robotics practically embrace all branches of the economy and acquire a universal character—from agriculture and extracting industries to the services sector, science and education. Information science interconnects at present the spheres of designing, producing and sale of goods, resulting in changes in the structure of production, making it mare flexible and operational, leading to the all-round decrease in demand for labour along with the simultaneous increase in the general volume of produced goods and services.

Of course, at the present stage of development, introduction of the achievements of technological progress does not mean that the number of jobs will be only decreasing in the labour market. It will be somehow compensated for by the emergence of new sectors and occupations in the most promising science-intensive high-tech industries—electronics, production of automation devices and, above all, robotics, bi-engineering, laser engineering and other industries. According to one forecast, about two million US workers will make, inspect and repair robots at the beginning of the 21st century. There will be growing de-

mand for designers of new machinery and for programmists in particular: 3.5 million programmists will be needed. It is obvious, however, that the new jobs will not compensate for the disappearance of the former ones, as more than 15 million workers are to lose their jobs in traditional industries in the United States alone, according to average estimates, by the beginning of the new century. New industries are, as a rule, labour-saving, they will thus absorb smaller numbers of workers.

According to most Western specialists, the development of microprocessor engineering and robotics affects employment most of all. These processes are relatively new, and that is why it is difficult to make generalisations or reliable forecasts. Nevertheless, the main features of their influence on the position and structure of the working class under capitalism can be discussed even now. The most extensive involvement in all the elements and stages of material production is a characteristic feature of microprocessor engineering. First of all, the very products of labour are changed. New products with built-in microprocessors demand new production technologies and reduced expenditures of working time. The number of mechanical machine elements required diminishes. And this, in turn, leads to a sharp decline in such production processes as metal-working, assembly and adjustment and

thus to a drop in the demand for specialists in these fields, even for those highly skilled.

On the whole, together with the general drop in employment, the number of electronics specialists in production tends to grow. These processes have manifested themselves most vividly in the watch-making industry, which has undergone qualitative changes in its production technology due to a change-over to production of modern electronic clocks and watches. Less component parts are needed now, there is less demand for mechanical assembly operations. One microprocessor replaces more than 900 components, reducing the time of production from 75 to 17 hours in manufacturing telexes.

Microprocessors and robots open wide fields for automation in those spheres where manual labour used to be considered irreplaceable: sewing, textile and shoe industries. A number of firms use computer-controlled lasers in cutting fabrics and special devices with computer control and photoelectron "vision" in the automation of the simplest sewing operations. Organisation of work and management in industries which used to be the main users of labour, especially in the automobile, chemical and electrical engineering industries, is being changed as a result of the introduction of achievements of modern electronics and robotics. Wide use of flexible manufacturing systems, all-purpose lathes with programme control

and robots has led to a sharp decrease in the number of workers in mechanical assembly industries first of all. The possibility of automation, by means of computers, of different functions of present-day production (designing, production management, technological preparation of production, etc.) gives the green light to creating fully automated production called "factory of the future" in the West. The creation of these kinds of industries will lead to a drastic elimination of workers of various qualifications — from low-skilled workers to designers and managers. And although mass-scale introduction of the so-called "manless" technology is obviously a matter of the future, it is clear even now that it will cause serious new problems in employment.

One more problem involved in the introduction of new technologies in capitalist society is the appearance of acute disproportions in the labour market. Apprehensions are even expressed that the working part of society may split into three components: autonomous, unprogrammed and replaceable workers. Those people whose work will not depend on computers in the near future, are called autonomous. This group includes the workers of the services sector in the main, whose number may be not so great. Unprogrammed workers are primarily scientific workers as well as members of those professions which, though they

use computers, still possess qualities which the latter still lack at present. It is clear that this sphere will also grow smaller along with the improvement of computers. And finally, replaceable workers are those who can be easily replaced by computers. Representatives of the last group supplemented constantly by people from the first two groups will be the main source of social tension, as they have limited opportunities to return to production.

A number of specialists believe the reduction of the labour force in production can be compensated for by growing employment in the services sector. Indeed, until recently the problem of unemployment was alleviated to a certain extent thanks to increased employment in the services sectors. In the USA, new mass groups of workers appeared in the trade and services industries (18 million in trade and 17 million rank-and-file wage workers in the services sector). However, the introduction of mini-computers and manipulators which has already begun here will eventually result in the fact that this sphere will not only cease "relaxing" unemployment, but will itself start throwing its workers on to the labour market. According to Carnegie-Mellon University estimates, 38 million of the 50 million white-collar workers — sales personnel and clerical workers as well as specialists making up the majority — will be replaced by machines. Forty five

per cent of the clerks in Great Britain will be affected by automation in the near future, 40 per cent — in the FRG. Computerisation of banks can in time cause the reduction of 30-40 per cent of their personnel.

It is difficult to give an exact forecast of the employment prospects in general. There are plenty of various and, at times, contradictory estimates — from forecasts of new increases in unemployment to hopes of almost complete balancing of the ups and downs of the labour force as a result of disappearance of some and emergence of other spheres of employment. Of course, employment may possibly grow in individual countries in certain periods of time due to various factors. However, the general tendency in the using of labour saving technology is obviously unfavourable for the working people.

It is doubtless that in the forthcoming 10-20 years there will be a considerable increase of structural unemployment. The steady process of releasing workers of mainly low and average qualification can be traced even today. The formation of two labour markets as a result of the multisided influence of the STR on capitalist society is now taking place. The first deals with highly skilled specialists and workers who can master the latest equipment and who get comparatively high wages. The level of unemployment is low here and vacancies occur. The other is

the market of outdated trades and low-income sections of general workers. The level of unemployment is high here and jobs are extremely unstable. Hence the poverty and deproletarisation of individual groups of workers. That is why there is increasing talk of a "double" society, society "moving at two speeds". On the one side, there are those who will get sufficient incomes. On the other — those who have no chances, who can at any time lose their jobs, who are doomed to low wages, to a weak social security system, who will need constant help.

The above gives grounds to some bourgeois researchers to affirm that the consequence of introduction of new technologies is not so much unemployment as the problem of the retraining of the labour force. Indeed, as some specialists consider, progress in computerisation of production will, by the beginning of the 1990s, result in the fact that the workers will have to change their trades every 4-5 years. Thus retraining of released workers and office employees might become the alternative to the growth of unemployment. Might, if the source of all the mishaps of bourgeois society did not lie in the objective contradictions determined by its antagonistic class nature but in merely insufficient amount of technical means to resolve them.

Retraining under capitalism can hardly acquire a mass character, especially when it con-

cerns middle-aged persons, female personnel or immigrants, i. e., those who are the first to became "unwanted". A worker under capitalism has, as a rule, neither the strength nor chances to acquire new know-how. The retraining programmes are gradually being curtailed in the majority of capitalist countries. More than that, the majority of new trades in demand on the labour market are inseparably linked with computers. However, according to special research data, the present-day worker over the age of 35 can hardly grasp the ideas of programming if he had no earlier corresponding experience.

It can be stated in general that the necessity of systematic retraining does not at all mean that it is open to general use in capitalist society. Such an opportunity will be given to as many specialists as the owner of the enterprise thinks it necessary in order to get maximum profits. In fact, there is no denying that monopolies and bourgeois governments are preoccupied with the problem of training specialists of requisite qualification. Still, they prefer to mould a "computer mode of thinking", training personnel to work with computers in secondary and higher educational establishments, that is, they create personnel for the future. Still, in view of the frequent change of specialisation in future (every 4-5 years), the worker with such training will lag

behind technological progress, and it will not secure him against dismissals.

Thus, unemployment is a direct consequence of new technological shifts under capitalist conditions, a specific social consequence of the newest stage of the STR, one of the greatest paradoxes of capitalism: technology opposes man instead of helping him, and does him harm.

Furthering of scientific and technological progress ensures the irreversibility of the process of the saving of labour. But then the fact of existence and, what is more, of growth of unemployment appears to be an inevitable result of the scientific and technological revolution. As to the striking contrast between the stable mass unemployment in the industrialised states of the capitalist world and complete employment in the countries of the socialist community, it can be easily explained away by declaring that socialist countries are technically backward and that low labour productivity leads to artificially high employment. This is the way bourgeois specialists usually reason. In short, from their point of view, things happening in the West now are the morrow of the socialist countries.

This reasoning is incorrect, first of all, because in the countries of the socialist community there are industries with a high and even the highest level of technology in the world. Of course, there are backward industries. However, this causes

the socialist countries to speed up the introduction of machinery of the latest generations and technologies to ensure revolutionary changes in production.

Nevertheless, it is proper to raise the question: will this jeopardise complete employment of workers under socialism? One cannot simply dismiss the fact that the era of electronics raises many questions in a new way. Mass reduction in the work force raises practical problems to be resolved tomorrow. At the same time, though problems arise, still the planned character of the social economy, which gives every opportunity to pursue comprehensive scientific and technological policies including social aspects of development, protects the socialist countries from the large economic disproportions which usually accompany the STR today in the capitalist world. An important part of scientific and technological programmes is the early solution of the question of labour resources. It can be achieved by means of the redistribution of labour which envisages strict correlation between released labour force and job-finding prospects, the required size of labour time reduction with the same wages and with due regard for the employment situation, and the retraining of the labour force in accordance with structural changes in production caused by the introduction of new technologies.

Technological reconstruction in the countries of the socialist community has a clear-cut social orientation. It demonstrates the fact that under socialism only jobs can be superfluous, not people. When, for example, 2,000 workers were released because of modernisation of equipment in the petrochemical industry complex in Schwedt, the GDR, they were all introduced to new production operations after appropriate retraining which was carried out without any social aggravations. The fact that the state tries not to infringe on the material interests of the working people, takes care of their timely retraining, is of considerable importance. Seventy seven thousand people were released in the course of the rationalisation of production in the GDR in 1986. Simultaneously, 260,000 jobs were created or modernised. The state bore all the expenses of retraining and improvement of skills in changing jobs.

A decree on restructuring production was adopted in Hungary in 1986 to outline the ways of improving or closing unprofitable enterprises. Under the decree, the so-called curement of an enterprise provides for the readjustment of its staff while its closing entails the abolition of jobs. In the course of the reconstruction of the industrial structure necessary to mobilise internal resources, additional sources are essential for financing the regrouping of the labour force. The

decision to close the enterprise is made if there is no way of improving the situation even through temporary credits or changing the type of production. What happens to workers in this case? Does it mean unemployment is inevitable? Nothing of the kind. The decree stipulates the cases when enterprise shutdowns are not permitted. For example, if the closing of an enterprise prevents its workers from being employed in the same industry.

Of course, the government and trade unions as well, realise that conflicts cannot be avoided in the course of reconstruction. To reduce them to the minimum is the aim of cooperation between trade unions and the state in Hungary. To regroup the work force, the state has for a number of years been financing the retraining of workers who became "superfluous" at particular enterprises. Although painful, nevertheless inevitable measures are being taken with due consideration of interests of both the national economy and the working people. In transferring people to new jobs they see to it that it would not take more than two hours a day to get to and return from a new job. Expected earnings are not to be less by more than 10 per cent as compared with what workers previously earned. In case of necessity an unemployment compensation is granted for a period up to six months: 75 per cent of the former average earnings during the first three

months, and during the second three months — 60 per cent. The Hungarian government, at the request of trade unions, allocated additional funds to resolve the problems of employment, improvement of vocational training, retraining of workers, expansion of housing construction.

Six million workers have been released from the USSR industries during the 10th five-year plan period (1976-1980) and 3 million during 1981-1984. But this "release" means that the worker changes his outdated work place to the more up-to-date one and, there in no way can one speak of any unemployment.

Of course, technological restructuring of production in the socialist community countries will at every stage pose new tasks to be resolved concerning the planned management of quantitative and qualitative changes of labour force both in individual enterprises and on the scale of every single country, and with the growth of socialist economic integration — on an inter-state scale. Technological progress indeed changes people's lives. Some change their jobs, some even move to other towns. But there are no human tragedies behind these changes, no loss of self-confidence or hopes for the future — as in the case of the jobless in the capitalist world. Social confidence of the working people in the countries of socialism lies in that they are certain: people, their well-

being are the main concern in any technological changes.

3. Historical Mission of the Proletariat: Illusion or Reality?

Scientific and technological progress exerts increasing influence upon the development of productive forces in industrial capitalist countries, causing great shifts in all the spheres of economic and social life, in relations between classes.

Changes affecting the contemporary class structure of society under the impact of the scientific-technological revolution attract no less, if not more, attention than changes in science, technology and engineering. Quite a number of works dedicated to this problem appeared in the West. During the postwar decades, theories sprang up in the industrially advanced capitalist countries brought about by the illusions that the achievements and opportunities of the scientific-technological revolution can be helpful in stabilising the capitalist order. The theories substantiated the ideas that capitalism as a social system had managed to cope with traditional conflicts, do away with antagonistic contradictions, integrate the interests of various classes and achieve socio-spiritual cohesion.

The power, as the well-known American econ-

omist and sociologist, J. K. Galbraith noted, in industrial society is passing now into the hands of "the technostructure", a kind of social product of technological progress — a large group of participants in "decision-making" and those who gained power over corporation. "Technostructure" includes all those who, due to their disposal of indispensable information and knowledge, can influence industrial process and thus, possess power in society. This social Utopia of the "new industrial society", he alleges, found its embodiment in the United States reality which is based on the principles of scientific and technological rationality.

These ideas, expressed as back as the 1960s, have something in common with the way in which Alvin Toffler attempts to represent the class structure of the modern "post-industrial society" in his book *The Third Wave.*

Toffler recognises the fact that society is divided into two social groups and even admits the possibility of a conflict between them. However, he regards possession of different degrees of knowledge, skills and the places people occupy in the political system or their relation to it as the main criterion of this division. Accordingly, he distinguishes the following social groups: specialists (engineers, scientists, economists, managers, cultural workers), technicians, employees and workers of the services sector. The main political

conflict, according to Toffler, now is not the struggle between labour and capital, not the social gap between the rich and the poor, but the conflict between those who support the established industrial society and adherents of the "third wave" society.

Thus, it became traditional with bourgeois ideologists not to recognise and hush up the fact that the economic inequality of people is linked with, and determines their position in the system of material production, their relations to the means of production. Lenin's words concerning bourgeois ideologists still maintain their relevance: "Confounding trade differences with class differences; confounding differences in the way of life with the different positions of the various classes in the system of social production — what better illustration is needed of the complete absence of scientific principles in the fashionable 'criticism' and of its practical tendency to obliterate the very concept 'class' and to eliminate the very idea of the class struggle." [1]

Of course, the scientific and technological revolution can and does lead to more or less similar changes in the qualification structure of the working class, peasantry, intelligentsia and employees under capitalism and under socialism as

[1] V. I. Lenin, "The Agrarian Question and the 'Critics of Marx'", *Collected Works*, Vol. 5, Progress Publishers, Moscow, 1973, p. 193.

well. The scientific and technological revolution manifests its influence first of all in the appearance of new, more complicated working skills which gradually oust the old ones, connected mainly with semi-skilled and hard labour. The workers of today are not like those of yesterday. Now that wage labour becomes increasingly complex expenditures on the general and special training of the labour force become significantly greater.

In the USA, for example, general expenditures on education and training have grown from $70.4 billion in 1970 to $240 billion in 1985. Only a quarter of industrial workers aged between 45 and 54 have a vocational training diploma or certificate, while workers of this level are two and a half times more among young people aged between 15 and 24.

Occupations in which workers, engineers, technicians and scientific personnel are employed are becoming increasingly differentiated. The number of people employed in agricultural production is sharply dropping. However, these changes in the social structure of society have different and sometimes quite opposite sociopolitical consequences in different social systems. Under capitalism they cause the class polarization and sharpening of social contradictions, while under socialism they intensify the process of development of social homogeneity.

The scientific and technological revolution cannot in itself change the class nature of state-monopoly capitalism since capitalist society was and remains split into two opposite camps: capital and labour. Antagonism between them is not only everpresent, but growing.

What changes are characteristic of the class structure of present-day capitalist society? First of all, the considerable growth of the army of wage labour is noticeable. Devoid of ownership of the means of production, wage workers now make up the great majority of the economically-active population in the advanced capitalist countries. The working class has especially grown in number. Ten million people have joined its ranks during the past five years in the United States alone. The socio-political role of the working class in society is becoming more and more important.

As to the class of capitalists and big landowners, it has considerably diminished. The layer of the ruling monopoly capitalists is opposed not only to the working people, but to one degree or another, to all other classes and strata of society. It can be seen that the proportion of urban and rural petty-bourgeoisie in the middle strata has become smaller: white-collar workers take priority here.

The scientific and technological revolution modifies certain specific features of classes in the

above structure, causes inner changes in classes and strata, in their way of living, their needs and characteristics. The bourgeoisie, for example, becomes increasingly parasitic in its nature: entrusting managers with entrepreneurial functions it becomes absolutely unnecessary in managing the process of production. More than that, the upper bourgeoisie buys and includes in its number the cream of managers, the managerial élite who are direct organisers of the exploitation of the working people. This fact gives rise to various theories of capital losing its leading positions in society and, thus, about the supposed "democratisation" of the bourgeois system. In fact, however, further concentration of capital is taking place under the impact of the STR and sharpened competition. The middle and petty bourgeoisie are not completely disappearing but their enterprises are becoming more and more controlled by monopolies. In the USA alone, for example, more than 2,000 farmers are being ruined and driven from their lands every week.

The scientific and technological revolution promotes the levelling of the living conditions and industrial functions of the intelligentsia and clerical workers with those of the working class. White-collar workers play an increasingly important role in the production of surplus value in the structure of the "aggregate worker". The core of the working class — the industrial prole-

tariat — increasingly absorbs various layers and groups. The peculiar feature of contemporary times is that the main source of the forming of such intermediate groups is not so much in the proletarising of the petty bourgeoisie as of the broad sections of intelligentsia and clerical workers.

Enhancement of the role and significance of the engineering and technical workers in contemporary production within the process of ever increasing replacement of labour by automation is receiving various interpretations by Western ideologists. Some think that evolution of society is leading to the gradual withering away of the working class. Just as the industrial revolution made horses unnecessary in production, it holds true for the worker today, especially in the stage of the introduction of microelectronics, according to the American economist Wasily Leontief.

Others believe the working class dissolves and loses its distinct features. Therefore, they allege it loses its role as the conscious and leading character of history. Thus André Gorz, making an absolute the processes of elimination of jobs and labour of functions of some workers as a result of automation, comes to serious political conclusions concerning the process of declassing the working class and its loss of its universal historic mission as the grave-digger of capitalism.

Nevertheless, it seems to me that adherents of these particular points of view do not want to

take into consideration the fact that the very existence of the working class is connected with its decisive role in production, in society and with such social phenomena as capitalist exploitation. As science and technology are today becoming the basis of material production, then to state under these conditions that the increased qualification and significance of mental labour leads to the disappearance of the working class, means to associate the working class only with manual labour and not with production in general. At the same time, there is a close connection between the progress of society and the changes in the working class. That is why, just as one cannot speak of the disappearance of the working class, so one cannot speak of the appearance of a new working class, or "neoproletariat" as Gorz terms it. Let us concentrate on this in greater detail. Today (as well as in the past), all those who create material wealth and are devoid of the means of production, are regarded as the proletariat. Emergence in the course of the STR of a number of new groups, with a transitional social status, expansion of the borderline zone between the working class and the middle strata, do not at all mean any obliteration of class distinctions, the appearance of a certain amorphous social formation. One should also note here: large groups of clerical workers and certain categories of rank-and-file engineers and technicians, and scientific

workers lose their former privileges. Their work is assuming a more and more subordinate character. These groups and layers, as regards their conditions of life and work and wages, are quickly approaching the status of the industrial proletariat.

All this means that the STR enhances the growth of the class confronting the capitalists, the growth of the army of participants in the anti-imperialist struggle. Monopoly attacks upon the vital interests and rights of the working people, when, under the impact of the STR, the material and spiritual needs of the working people are growing, intensify social protests. Economic and political motives for the class struggle of the proletariat are increasing. This creates new stimuli and evokes new forms of this struggle. The range of demands advanced is becoming wider. The proletariat demands that not only wages be increased but also taxes and rent be cut. It also calls for measures to be adopted against inflation and the increase of prices, and against environmental pollution. It demands guaranteed jobs, payment of unemployment benefits, strengthening of the whole system of social insurance, extension of human rights. The proletariat fights for peace and disarmament. Contradictions between the main classes of capitalist society are growing more acute and only the perspective of socialism can help to resolve them.

4. Capitalist Society Gives No Social Rights in the "Age of Prosperity"

Up-to-date technologies open fantastic opportunities for a tremendous increase in labour productivity which in itself seems reason enough to create the objective prerequisites for the improvement of living standards and increasing wages. However, in reality, quite the contrary is taking place. The owners of the enterprises are doing all in their power to use the increase in labour productivity for maximum profits by appropriating to the maximum the share of surplus value created by the labour of the working people. Wages are maintained at the minimum possible level and are increased only as a result of fierce struggle of the working people and trade unions or when there exists a temporarily high demand for certain categories of labour. But even with the increase in wages, they still lag far behind the growth of profits. In the FRG, for example, nominal wages of workers and employees saw a ten per cent increase in the period between 1980 and 1985, while the increase of net profit of capitalists for the same period was 40 per cent. The exploitation of the working class intensified though absolute wages were increased.

Facts of this kind are used by a number of bourgeois economists and political leaders to substantiate the statement that the STR confronts us

with a dilemma: either high wages and a low level of employment, or a high level of employment and low wages. In other words, the unemployment of one is a guarantee of high wages of the other. However, as capitalist modernisation reveals, the time-tested method of the previous century — that of using mass unemployment to intensify exploitation of the working class — has become a basic weapon of social revenge of the capitalists of today. The workers, in constant fear of finding themselves on the street, become more complaisant, less demanding as regards the payment for labour, its security and social insurance.

As *Business Week* magazine noted, "revolution in working rules" has been going on in industry and the services sector in the USA — a new stage of rationalisation which prolongs working hours and intensifies labour. The owners of aviation companies compelled civil aircraft pilots to extend their flying time without increasing their salary, owners of trucking and railway companies introduced the system of payment by the hour for truck and engine-drivers instead of the previously used payment per mile of a run. This led to the considerable lengthening of their working hours. Owners of many enterprises abolish or reduce breaks during the working day without increasing the remuneration. Managers of the machine-building enterprises "revolutionise" working conditions mainly by increasing the

number of overtime jobs for usual payment, extending the functions of the workers making them do more than one job.

"It is a question of the same amount of work to be fulfilled by fewer people, or greater amount of work done by the same number of people,"— this is how the manager of one of American companies characterised the essence of the "new working rules" imposed upon trade unions. The owners of the enterprises grow rich not only through the technological reconstruction of production by introducing automatic machinery which replaces man's labour, but through the very threat of such a reconstruction. *Fortune* magazine gave as an example one of the plants in Wisconsin, USA, which successfully competes with enterprises where automatic lines have been installed. The secret of high productivity on this "miraculous plant", the magazine writes, is in the intensive use of the labour force. The workers have only one six-minute break during their working day, they run, never walk to work.

New technology helps employers to intensify control over workers, their work and conduct. Computers are used not only in managing various processes, but also to control every movement of a worker. A new kind of Taylorism is being born here — "computerised Taylorism" which penetrates the services sector as well. In combination with other technological equip-

ment, computers are used to supervise salesmen, cashiers, communication workers, medical personnel. Moreover, the scope of supervised categories of clerical workers is being extended. In general, intensification of control over the worker is aimed at increasing his exploitation, turning him into a meek appendage of a machine.

Striving to increase exploitation, US and West European employers are turning to the experiences of their Japanese competitors. Following the latter's example, they have set up so-called "quality groups". In such a group, a worker himself has to find, analyse and resolve problems of improvement of quality, production technology and reduction of the material-intensity of production. New forms of exploitation of creative potential of the working people bring quite a great deal of additional profit under conditions of intensified competition on foreign markets. The Japanese example of intensifying physically and psychologically the amount of work by a worker, as Western industrialists think, deserves to be emulated. And although the level of automation is much higher, individual output of a worker which is much higher, is the decisive competitive advantage of Japanese big business. Such a classical form of exploitation as the duration of working time which is much longer in Japan than in other developed capitalist countries, ensures considerable profits for Japanese firms.

Only 27 per cent of all the wage workers have two days off. More than half of the Japanese workers, as sociologists state, use only 2 or 3 days off a month and have only one leave every two or three years out of fear of being considered slack and of losing a job.

According to *Business Week* magazine, exploitation of women is a key factor which made Japan a powerful competitor on the world market. Legalised discrimination of women, who make up 40 per cent of all wage workers, brings great profits to Japanese business.

According to official estimates, average wages of women in Japan are 52 per cent, and in a number of industries, even a third of men's earnings, while they range from 60 to 70 per cent in other capitalist countries. This results in a high percentage of women among those who live below the poverty line. In the USA, for example, the figure is 61 per cent.

Racism still maintains its positions as an effective means of deriving superprofits. The incomes of Afro-American families are 40 per cent lower than the average family income in the USA. 60 per cent of young Afro-Americans are jobless, 30 per cent of the Hispano-Americans live in poverty.

We can see that arsenal of methods employed by exploiters today to squeeze profits out of a worker is quite varied — from such time-

tested methods as the increase of working hours, use of female and child labour, to the latest forms — "quality groups" and "computerised Taylorism".

In practically all developed capitalist countries, together with a decline in real wages, considerable increase in the intensity of labour and worsening of conditions has recently been observed. This is the result of progressing insecurity of workers who suffer persistent mass unemployment. Partial employment, flexible forms of organisation of labour also create more favourable conditions for attacks on wages and rights of workers. Part-time workers are less secure in labour legislation and labour agreements (on wages), than permanent workers. They more easily give in to the demands of employers. This is revealed in the fact that, when unemployment reigns supreme, tendencies toward wage-freezes and cuts are especially strong. In Ireland, for example, with its level of unemployment being especially high — 18.5 per cent — wages rank among the lowest in Western Europe.

In considering the influence of modernisation of production on the living standards of the people it is also important to emphasise that increased labour productivity, lowering of labour intensity per unit of output, could be expected to result in the reduction of prices of goods and thus promote the improvement of the people's

well-being. But in reality quite the contrary is happening. Under the pretext of the need to compensate for growing production expenditures caused by the introduction of new expensive machinery, increase in workers' wages, rising prices of raw materials and fuel, big business repays itself with interest by means of intensified production and by rising prices as well. Real wages in the FRG in 1985, taking into account rises in prices, not only did not increase, as compared with the end of the 1970s, but were six per cent lower than the level of 1979. Real wages of the US workers have been reduced by more than 16 per cent over the last ten years, while labour productivity has increased 65 per cent.

The degree of exploitation of the working people is constantly growing as a result of the rise in prices outstripping the increase in workers' earnings and growing intensification of labour productivity. Victor Perlo, a well-known US economist, notes that the rate of surplus value in the US manufacturing industry almost doubled in the period of 1953-1980: US workers now spend two hours to produce the value of their labour and six hours to produce surplus value, which is three times as much. Thus, the impact of scientific and technological progress leads, in the end, to the enhancement of the process of redistribution of incomes in favour of monopolies. The rich become even richer and the poor poorer. Despite great

achievements in science and technology, very few things have changed in the essence of capitalism which Marx characterised in the following words: "There must be something rotten in the very core of a social system which increases its wealth without diminishing its misery..." [1]

By pleading the need to modernise production, to find resources for corresponding capital investments in order to maintain "competitiveness", they justify their offensive on the working people's living standards by cutting social expenditure, "social dismantling" which has been intensively put into practice in many capitalist countries in the past few years. Expenditures on public health services, assistance to the poor, various allowances and unemployment insurance are being curtailed.

The present situation in capitalist countries makes one recall Lenin's words. He wrote that the "...improvement in technology signifying increased labour productivity and greater social inequality, of widening gulfs between the rich and poor, of greater insecurity, unemployment, and various hardships of the mass of the working people." [2]

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[1] K. Marx, "Population, Crime, and Pauperism", in: Karl Marx, Frederick Engels, *Collected Works*, Vol. 16, Progress Publishers, Moscow, 1980, p. 485.

[2] V. I. Lenin, "Draft programme of the R.C.P.(B.)", *Collected Works*, Vol. 29, 1977, p. 101.

5. Upon Whom Does the Electronic Eye Spy?

"Cyberveillance"— this ominous word means constant surveillance of citizens by means of cybernetic methods and systems. This word has just appeared in the English language and has gained wide popularity of late on the pages of Western newspapers and magazines. These systems help to keep the situation under constant control, process information quickly and generate signals for making decisions. Cyberveillance is a powerful potential means in the hands of the state to struggle against opponents of the existing social regime; it is a system of total spying and surveillance based on the latest achievements of scientific and technological progress. Exposure of the activities of the FBI, in particular, aimed at collecting dossiers, electronic eavesdropping and spying on US citizens, showed that these fears are not without foundation.

It becomes increasingly apparent that together with other negative consequences, the STR provides new opportunities for a capitalist state to abuse its power, coverly violate constitutional freedoms, and turn into a police state. Scientific and technological progress has provided the capitalist state with new means of supervision over individuals. By means of various equipment,

it can eavesdrop on private talks not at all meant for other ears. The development of information equipment has made it possible for the capitalist state not only to keep "politically unreliable" individuals under surveillance, but to collect, process, manipulate and store a vast amount of information collected about almost every inhabitant of the country.

In a word, computers can lead to total surveillance. A person is simply afraid of doing or saying something with the assurance that his words or deeds are not being registered somewhere. Modern transmitters with microphones can be the size of a pin's head and can be installed everywhere — on the wall, on the ceiling, in the armchair, in personal clothes. In films dealing with spies, characters often talk in subdued voices with loud music coming from the radio. However, in real life if sounds are transmitted by several mikes hidden in the room, a computer can compare sound traces under various angles, selecting voice vibrations and removing other noises. Still, there are ways to even do that without microphones. Laser beams are sent to a window or some other surfaces vibrating under the impact of acoustic waves. The beam registers the tiniest vibrations and sends them back to a computer which transforms them into sounds. Thus, there is a way of registering people's conduct in any surroundings, record all they say

to each other over the phone, at home behind closed doors, in public places.

Many facts and data reveal the scope of surveillance of citizens in capitalist countries. For example, an investigation carried out by the US Senate Committee on the Judiciary revealed that federal departments alone possess 858 automated archives with 1,250 million personal records and dossiers on US citizens and various organisations. The Committee arrived at the conclusion that they store information practically on every US citizen. These dossiers are replenished with information illegally obtained from letters opened, telegrams read, telephone conversations tapped.

At present, a great number of various data banks are being established in capitalist countries. They are used in resolving a great variety of problems in the fields of: administration, personnel, social security, maintenance of public order, judicial proceedings. Experts believe that multipurpose data banks constitute a serious threat to the individual in capitalist society. The point is that the quantitative growth of information in the "electronic era" is quick to acquire new qualities due to the possibility of replacing, regrouping and centralising information. Thanks to the exchange of information between various departments, it becomes possible to draw a psychological portrait of the individual, his political out-

look, financial status, private interests and hobbies, secret vices and intimate habits. Police, insurance companies, educational and social security bodies, exchange mutually supplementary information. Information obtained for one purpose can be used in resolving other problems. All this results in the potential threat to freedom of the individual and helps to manipulate citizens' behaviour. Data banks, eavesdropping, spying and cyberveillance in capitalist society are not ends in themselves. They have auxiliary functions in resolving a more complicated task — that of establishing by means of the latest technology the apparatus for manipulating the consciousness of the broad masses.

6. Gangster with "Electronic Master-Key"

"Electronic crime"— this combination of words can hardly cause any surprise today in the developed capitalist countries. More than that, it has already become clear that the development of electronic equipment and crime can go hand in hand. The new criminals do not kill witnesses and never wear masks. They do not threaten their victims with pistols and do not practise purse-snatching. Still, experts think, the damage done

to the economy by crimes committed with the aid of computers in the developed capitalist countries, is comparable to the gains derived from their introduction. Moral losses cannot at all be estimated. How can one commit a crime by means of a computer which is the most promising weapon of crime in the future?

Most computer crimes are committed during working hours, routine business operations. These are mainly embezzlements and misappropriations committed by confidential agents of companies or other organisations who abuse their positions to take possession of the companies' money. These involve false financial operations, non-existent bills and compensations for disability paid to non-existent employees and many other operations. And what puts these activities in a class by themselves is that after the money is transferred, all signs of the criminal operation are eliminated from computer memory. As the majority of detected electronic crimes of the kind testify, only the insatiable appetites of criminals and the exceedingly large sums of thefts, as well as pure coincidences lead to detection.

The crimes detected testify to the vivid fact that electronic crimes are big business. According to some estimates, in the USA alone, the sum of frauds committed by means of computers, annually averages $3 billion. However, as most US experts believe, detected crimes make up

only a small part of all the crimes, i. e. no more than 5-15 per cent of the overall number. Besides, as statistics show, the number of crimes does not only parallel the growing number of computers, their volume grows as well. This kind of crime is an invention of the computer age. It was simply impossible before. Minimal risk, no violence and great profits — all this stimulates the growing number of crimes committed by means of computers in geometrical progression, US criminologists believe.

Wide use of computers in financial settlements by means of credit and cheque cards, opens wide opportunities for computer crimes to individual rogues and to organised crime as well. It is all the same for the computer whether it deals with the real owner of card or with a thief who has stolen it. It needs only a code number. Anonymous financial settlements by means of cards have stimulated wide use of stolen or false cards. In addition to criminal operations with cards, fraud by means of stolen, devalued or false securities has become widespread.

"Electronic master-keys" (access codes) are employed not only in criminal operations. Information itself, even if it does not lead to enrichment, is of great interest in the age of electronics.

Unlawful retrieval of secret information from computer systems is of great interest to research units of the biggest Western banks and corpo-

rations. They are interested, in particular, in obtaining information they need concerning their competitors. The modern level of computer technology and the possibilities it possesses permits not only to illegally withdraw necessary data from information data banks, but to insert additional data, manipulate information stored in them, or erase data depriving their competitors of the opportunity to make prompt decisions. The damage the economy suffers can be estimated in gigantic sums. Any recognised firm or governmental organisation, such as the Bank of California, Massachusetts Institute of Technology, US Department of Defence subdivision, etc. can become a victim of hackers making use of information.

The story of the Milwaukee group of hackers who called themselves "Club 414" after the telephone code number of the city, is perhaps the most well-known example of illegal intrusion in "electronic memory". In the city of Milwaukee, Wisconsin, at the end of the summer of 1983, there was a great excitement. It appeared that a group of schoolchildren found access to information which was previously available only to a limited circle of experts. Ciphered data were put in storages of various computers in computer centres of the United States and connected with the usual telephone line, so that in case of an emergency, information could be obtained in the

shortest possible time. Connecting their personal computers to phones, those young hackers managed to reach out to various computers and, after ascertaining an access code, hours on end would test its brain, retreive information and feed in new programmes... They were stopped only after penetrating the computer of the nuclear center in Los Alamos. It is notable that the activities of "Club 414" were confined mostly to the testing of computer data they joined up with.

There are, however, facts of a less harmless nature. The following case was heard in US Congress.

A particular group of hackers after getting connected to a US Department of Defence computer and finding out that the information they discovered was top-secret, tried to circumvent safeguards to make the computer order the launching of a missile or the combat use of other weapons. "War Games", a sensational film in the USA, gives one an idea of what could have happened in such a case: a schoolboy connecting his personal computer to the missile-controlling computer nearly started World War III.

However, according to Pentagon experts, servicemen pose a much greater danger than teenagers with "computer disease" who derive the greatest pleasure from penetrating into information systems. Equally threatened are both powerful computer systems and small one-purpose

computer devices fixed at missile warheads and even at artillery shells. If, after obtaining the access code, the system is penetrated, there is the chance to get at the data kept in storage, change the previous programme and circumvent safeguards. It is practically impossible to check any illegal penetration. With the changes introduced, there is a danger that computers supervising, for example, ballistic weapons can retarget missiles.

A real nuclear conflict was finally prevented in the film we referred to, but in fact it is not entirely impossible that one day a mere "electronic game" of a serviceman or teenager should activate a nuclear-missile control system.

Chapter Five TO BE OR NOT TO BE: WILL THE SCIENTIFIC AND TECHNOLOGICAL REVOLUTION SAVE THE THIRD WORLD?

Due to its global scope, the scientific and technological revolution draws into its orbit not only capitalist and socialist countries but the developing nations. This is first of all confirmed by the fact that many developing countries rapidly set up basic sectors of modern industry such as power engineering, metallurgy, machine-building and the petrochemical industry which, to a certain extent, set the pace of technological progress in other economic sectors. In the past decade, the annual growth rates of industrial production in the Third World countries stood at 5 to 7 per cent, which exceeds the corresponding figures for the industrialised capitalist coun-

tries. The states comprising this socio-economic region are major world suppliers of valuable primary materials and products. For instance, two-thirds of the oil is extracted by the countries situated in the Indian Ocean region, while the newly-free states account for 90 per cent of the world output of rubber, tea and jute, 81 per cent of gold, 57 per cent of tin, 28 per cent of bauxite-mining, a substantial share of copra, sugar, coffee, timber and various tropical fruits.

Nevertheless, we can speak only about the first steps taken by the newly-independent states to attain the modern level of industrial, scientific and technological development. UN estimates indicate that the developing countries where about 70 per cent of the world population live, account for just about 7 per cent of world industrial output.

Now, what obstructs scientific and technological progress and industrial development in the Third World countries? Why don't the expectations previously pinned on the scientific and technological potential for overcoming the socio-economic backwardness of the developing countries materialise? Why is the scientific and technological revolution unable to bridge the gap between the industrialised and developing countries in their development levels?

1. Scientific and Technological Revolution and Technological Neo-colonialism

The accelerating scientific and technological progress and industrialisation in the developing countries encounter tremendous difficulties exacerbated by the neo-colonialist policy pursued by the industrially developed capitalist states. They shift the burden of economic crises onto the shoulders of the Third World in an attempt to hamper its development and use their scientific and technological superiority to pump increasingly higher profits from the developing states. By hook or by crook the imperialist states attempt to tie the latter to themselves so as to achieve easier access to their natural wealth and use the territories of the developing nations to carry out their own strategic designs.

The attainment of national sovereignty by the developing countries did not remove the powerful levers the capitalist countries employ to exert economic pressure on the overwhelming majority of the newly-free countries. The preservation of the socio-economic backwardness of many developing countries is an immediate result of their economic orientation primarily towards the major capitalist countries, the involvement of the developing states in the international capitalist division of labour and the formation of neo-colonial structures in their economies. By stimu-

lating the processes engendered by the international capitalist division of labour, the STR aggravates the contradictions between the Third World and imperialism since in its neocolonialist policy the latter is using breakthroughs in science and technology on a broader scale as the most powerful means of subjugating and exploiting the developing countries.

The predominance of deeply-rooted archaic economic structures (semi-subsistence, patriarchal-tribal, semi-feudal and small-scale commodity) should be listed among the major internal factors impeding the scientific and technological revolution in the developing countries. Underdeveloped national capitalism constitutes also an obstacle to the development of science and technology because small or medium-scale entrepreneurs cannot set up modern factory production employing the most up-to-date and, as a rule, the most expensive equipment and technologies which require skilled personnel. It is still more difficult to organise one's own research and development (R&D), for these countries lack both money and equipment.

Relying on its technical superiority, modern imperialism is extensively using a new variety of control: scientific and technological monopoly. It basically involves: the growing concentration of production, distribution and application of scientific and technical know-how in a limited group

of capitalist states, the isolation of Asian, African and Latin American countries from scientific and technological progress, the establishment of a system of the international division of labour in which economic inequality would be augmented by scientific and technological inequality.

Scientific-technical or, as it may be also called, technological neo-colonialism is gradually becoming a major form of the exploitation of the Third World countries by capitalist powers. Newly-independent states are lagging far behind the leading capitalist countries in R&D allocations which is a vital indicator of scientific and technological development. Thus, in the mid-1970s the annual per capita expenditures on science were as follows: in the USA — $110.5; in Britain — $39.8; in France — $27.1; in West Germany — $24.6; while in Asian countries the corresponding average was $0.38; in Arab countries — $0.3; in African countries (Arab states excluded) — $0.4; in Latin American countries — $1.25. On the whole, over the same period the aggregate annual allocations for science stood at $47.5 per capita in the developed countries compared to $0.51 in the developing states. Despite the fact that by now allocations for science have increased in all countries, the gap between the imperialist and developing states has widened, instead of closing. Today Asian, African and Latin

American countries account only for 3 per cent of the world expenditures (socialist countries excluded) on the development of science and technology.

This situation, which has developed as a result of the scientific and technological lag of the Third World countries and the survivals of neocolonialism and various forms of inequality, drastically impedes the STR. And even the most modest achievements are primarily due to the transplanting of scientific and technological achievements from the capitalist countries rather than as a result of improving internal conditions. And all this is totally in line with the nature of the industrialised countries' political system. International capital is dead set on tightening its control over the introduction of the results of scientific and technological progress in the world capitalist economy. Monopolies employ their investments in the economies of newly-free states as an efficient instrument for using their cheap raw materials and labour. Here account should also be taken of the fact that most of the production capacities set by foreign capital, are in no way integrated into the developing countries' economies, instead they are export-oriented.

2. Transfer of Technology: A Technological Trap Laid by the West

The present stage of the STR is marked by the intensification of international scientific and technological ties used by the developing countries in an effort to resolve a number of intricate problems involved in the elimination of their centuries-old socio-economic backwardness. Despite the fact that modern technologies are highly sophisticated and capital- and science-intensive, the developing countries cannot avoid using them. A different approach would further widen the technological and social gap and exacerbate the scientific, technical and economic dependence of the newly-free states. Most of these countries borrow finances, techniques, technologies, know-how and managerial experience from the capitalist countries.

Their own underdeveloped scientific and technological base makes the developing countries seek the importation (transfer) of technology as a way out of their predicament. Here, the transfer of technology is perceived not as a chance undertaking but rather as a process involving the selection, acquisition, adaptation and assimilation of imported technologies when the technologies are treated as the material and non-material embodiment of scientific and technological progress. The demands of socio-economic develop-

ment encourage a steady growth of the developing countries' importation of technology. Modern capitalism makes the transfer of technology, which is basically a progressive phenomenon with a significant potential for the development of young states, into an instrument of imperialist expansion and neo-colonialism. The transfer of technology and scientific and technological progress are accompanied by the imposition of new forms of dependence on the developing countries.

The capitalist market of technology is a smoothly-running mechanism for reproducing the economic dependence of the developing countries at a higher level of the development of productive forces. By acquiring technology, developing countries receive technical know-how and certain types of technical equipment. However, the transfer of technology from the industrially developed countries of the West to young states, frequently involves certain difficulties instead of stimulating progressive development. Not only does it fail to decrease the technological gap between the developing countries and the exporters of scientific and technological novelties but, as a rule, expands the rift.

Besides, one should take into account that a substantial part of technology comes to the developing countries via transnational corporations (TNCs) which account for about 45 per cent of

technology sales in the world and whose policy is hardly conducive to the solution of urgent problems linked to overcoming the backwardness of the young states. By vigorously participating in the most up-to-date research, organising science-intensive industrial production and transferring technologies to many countries, the TNCs pursue their own selfish goals. First of all, they strive to ensure their superprofits and tie the developing countries to the world capitalist system as fast as they can. Transnationals' activities in the developing countries adversely affect the development and consolidation of their own scientific and technological potential.

Why does this happen? First of all, because TNCs transfer only those technologies which no longer set the pace of scientific and technical development and are rather obsolete. In addition, TNCs place in developing countries such lines of production and subsidiaries which are nothing but separate components of the production cycle. Capital- and science-intensive elements of this cycle are located in developed capitalist countries, while labour-intensive, technologically primitive or polluting elements of production are located in developing countries with raw-material resources and a relatively cheap labour force. In conditions of instability and crises of the capitalist market, transnationals, with their powerful scientific and technological base, are capable of

switching over to new lines of production and adjusting themselves to new economic conditions. The developing countries, on the other hand, sustain heavy losses and become still more dependent on developed capitalist states. All this widens the technological gap between the developing and developed capitalist countries. Moreover, this rift will grow primarily due to the qualitative, rather than quantitative, factors in the development of productive forces.

The fact that the most intensive introduction of high technology begins in the war-related, rather than civilian industries is another major impediment to bridging the "technological gap" and leads to its relative extension. Experts of the Independent Commission on International Development Issues headed by Willy Brandt, noted in their report that the terrible irony was that the "most dynamic and rapid transfer of highly sophisticated equipment and technology from rich to poor countries has been in the machinery of death". [1] Over the period between 1971 and 1980, the military expenditures of the developing countries grew 2.5-fold to reach $74 billion. Besides, the stockpiling of weaponry proceeds not only in quantitative but in qualitative terms, and

[1] *North-South: A Program for Survival.* Report of the Independent Commission on International Development Issues, The MIT Press, Cambridge (Mass.), 1980, p. 14.

the number of the developing countries possessing the latest types of weapons is rising.

The use by the developing countries of the latest scientific and technological achievements to manufacture arms instead of employing them to consolidate their economic basis has particularly negative consequences for these countries. While only two decades ago the developing world had no military industry to speak of, now more than 30 countries in this zone produce armaments and in 1980 their share in the world arms exports amounted to 2.2 per cent. Since the early 1980s, the developing countries annually have spent $100 billion for military purposes. On average, military allocations exceed those for health care six times and for education — three times. Military expenditures are growing at a much faster rate than the GNP. Over the last twenty years these have grown 4.5-fold compared to a threefold growth of the GNP.

The efforts of the young national states to eliminate inequality and discrimination in international scientific and technological relations are basically aimed against imperialism. The developing countries are aware of the neo-colonialist essence of the technology-transfer policy pursued by foreign monopoly capital and are justified in demanding the restructuring of the international technological order. The effort of the newly-free countries to use scientific and technological prog-

ress to eliminate social and economic backwardness is reflected in their programme for the establishment of a new international economic order and in the demand to elaborate and adopt a universal Code of Conduct in the field of technology transfer which is expected to facilitate this transfer and make it less expensive. The satisfaction of these demands would facilitate the scientific and technological development of the newly-free countries.

However, experience shows that one can hardly expect an instant success in the democratisation of the international transfer of technology. The developing countries still have to wage a protracted, uphill struggle for the practical realisation of their demands.

The socialist countries, serving as an example of equitable cooperation, assist newly-free countries in setting up their national industries, consolidating their positions on the world market, training technical and scientific personnel, etc. The transfer of technology from the socialist countries radically differs from the transfer of technology from the capitalist countries with the latter using it as an instrument for the neocolonialist exploitation of the newly-free states. The socialist countries support the just demands of these states and believe the Code of Conduct should regulate the transfer of technology of all countries without breaking them up into sep-

arate groups, be based on democratic principles and should not contain any discriminatory provisions as regards some countries or groups of countries. The developing states can rely in their struggle on the assistance of the socialist countries which are natural allies of the national liberation forces. Their concerted efforts offer new opportunities for setting the international use of scientific and technological achievements free from neocolonialist bonds.

3. Talent Snatching

In the major capitalist countries, a typical feature of the present stage in the scientific and technological revolution is the intensive use of cheap labour from the developing Asian, African and Latin American countries. Still, despite the fact that most of the immigrant workers are unskilled or semi-skilled, highly skilled specialists and intellectuals also account for a conspicuous share of the immigrants. This phenomenon, referred to as either "the brain-drain" or "the intellectual emigration", i. e. emigration of skilled personnel predominantly from the developing to major capitalist countries, has become particularly pronounced since the second half of the 1960s. Taking into account the adverse effect of this process on the scientific and technological potential of

the developing countries and their intellectual depletion, as well as the advantages and profits consequently derived by the industrialised nations, the brain-drain was also dubbed "the reverse transfer of technology". According to UNCTAD, in the course of fifteen years more than 300,000 specialists from newly-free countries emigrated to the USA, Britain and Canada. Since the early 1980s, about thirteen thousand specialists from the developing countries annually settle in the United States alone.

The brain-drain, for all intents and purposes, is actually a theft of talents, highly skilled specialists. This is a theft because as a result of the large-scale transfusion, the industrially developed capitalist countries steal from the developing states tens of billions of dollars. On the whole, it is quite difficult to estimate the losses sustained by the developing countries through the emigration of the most valuable national personnel because these losses are diverse and do not easily submit to a quantitative appraisal. However, taking into account the weak scientific and technological potential and economies of the developing countries, any estimates indicate that these losses are catastrophic and irreparable.

According to UNESCO data, from 1949 to 1969 some 143,000 top-grade specialists emigrated to the USA from the developing countries.

The US Life Insurance Institute estimates that the costs involved in their professional training alone, amount to five billion dollars. If one adds the estimated $440,000 in average profits brought by every college graduate to his employer over a twenty year period of work it means another $63 billion. Considering the fact that the brain-drain is rapidly expanding these sums can be multiplied many times. Emigrant specialists are primarily medical personnel, as well as teachers, scientists and engineers.

We can identify two basic forms of brain-drain. First of all, it is young people who travel to the West to continue their education and stay there when they get their degree, or in other developed countries. The second major form is emigration of citizens from the developing countries where they get their education and subsequently leave the homeland to work in Western countries. The brain-drain scale is confirmed, incidentally, by the fact that today every fifth university graduate under contract in the USA is a native of a Latin American country. According to UNESCO, Latin America annually loses 8 per cent of the graduates of its technical colleges and 20 per cent of the graduates of the humanities due to the "export of specialists". And the West skims the cream on this, as a rule.

The general economic, and particularly scientific and technological, dependence of the deve-

loping states on the developed Western countries, foreign capital and, first and foremost, transnational corporations, is the economic basis for the emigration of specialists and the main lever ensuring the "brain transfusion". It would be naive to believe, however, that the outflow of specialists from the Third World countries is a spontaneous phenomenon, and an objective process engendered exclusively by the law of supply-and-demand in conditions of the continuing imperialist monopoly of scientific and technological progress in the capitalist economic system.

The brain-drain is stimulated by the policy of the leading imperialist powers which encourage the influx of specialists from the developing countries. It is stimulated by the inculcation of alien values and stereotypes of Western culture, ethics and moral values and the general orientation on the Western way of living. It is the result of the underdevelopment and deformities of all facets of the economic and social structure of developing countries. Education and other grants provided by the West are a powerful force of attraction for young talents. A prominent role here is played by cultural foundations which are sponsored, as a rule, primarily by TNCs. The United States and other Western countries quite often render financial and other aid to scientific programmes in developing countries. This "aid", however, overtly or covertly pursues the

goal of deriving substantial profits for themselves. A by-product of this aid is the outflow of specialists to the donor countries.

The outflow of skilled specialists and the need for a more consistent policy of the developing states in the field of education, have been discussed more than once by UN General Assembly sessions, in UN specialised agencies, particularly UNCTAD, at conferences of the heads of state and government of non-aligned countries and other international forums. Socialist countries make their unselfish substantial contributions by assisting the developing states in personnel training. The young states themselves are striving to take various steps, including economic and legal measures and information campaigns to reduce the outflow of skilled labour. In particular, they introduce measures to streamline the management of science, coordinate it with education, and plan ahead national needs in scientific and technical personnel.

However, these steps have failed to produce the desired effect. For example, in India where the brain-drain problem is particularly acute (according to UN data the country loses $17,200 just on the education of a scientist leaving the country), the efforts of the government and *ad hoc* programmes initiated and financed by the UN, thus far have failed to stop the outflow and bring back the expatriates. Recently the government of

India announced its plans to establish a new "technological city" where Indian scientists currently working abroad will be offered appropriate conditions for their work and salaries on a par with those they get in the USA and elsewhere in the West. By creating this centre the government hopes to reverse the brain-drain. However, even at the planning stage apprehensions were voiced that such a centre could lead to an unjustified polarisation of Indian scientists and, moreover, could trigger off a new wave of the brain-drain of scientists who now work in India.

By manipulating and encouraging the brain-drain, the imperialist powers are striving to frustrate the social progress of the young states, preserve neo-colonial dependence and perpetuate economic and political inequality. Despite the importance of the efforts made at international, regional and national levels, the problem of the outflow of skilled personnel from the developing countries can only be solved on the basis of radical socio-economic reforms which would necessarily curtail the activities of foreign capital and first of all the activities of transnational corporations.

4. Friends Sham and Real: How Much is the "Aid"?

Due to the insufficient internal financing and a limited scope for the development of scientific and technological progress, external resources have always constituted an important instrument of financing for the developing countries. Drawing on the external sources, most of the young states cover from 15 to 60 per cent of their national development programmes, and the importance of these sources continues to grow: most of these countries experience a lack of resources, while their balance-of-payment deficits are swelling and they have to pay more to meet their debt obligations.

The monetary-financial situation of the developing countries has been steadily deteriorating for several decades. This trend is the result of the predatory exploitation of their natural and manpower resources by the imperialist states, the outflow of the profits made by transnational corporations, as well as the exacerbation of the general crisis of capitalism and other negative external factors. All this put the young states in a tight corner.

The attempts of the developing countries to ease their monetary and financial situation do not always bring tangible results since the causes of the deterioration are often beyond their con-

trol. As a rule, these causes are rooted in the selfish policies of capitalist countries and their efforts to shift their own problems and difficulties onto the backs of the young states and introduce all their contradictions and shortcomings into the economies of these countries. Besides, the structure of financial receipts of the developing countries is undergoing profound changes harming their economies: the share of easy-term loans is dropping, while the share of costly, private, as a rule, credits on the terms of the capitalist market is correspondingly expanding.

State aid for development is the cornerstone of the imperialist financial policy as regards the developing countries. The West grants "aid" on a bilateral interstate basis primarily to the countries ruled by anti-democratic regimes which are assigned a special role in the military-strategic plans of imperialist countries. The USA grants aid, as a rule, subject to the developing countries' renunciation of their "erroneous political doctrines" and the curtailment of the state sector. Besides, this aid is calculated to create an economic and political climate conducive to the subsequent large-scale intervention of private capital. This is instrumental in acquiring sources of primary materials and the subsequent plundering of young independent states. Later on, capital reaps a hundredfold return on the extended financial "aid". Thus, according to the UN Centre on

Transnational Corporations, in 1980-1983 direct foreign investments in Africa amounted to $5.5 billion, while $22 billion was pumped out of them, which makes a 400 per cent profit.

Under this aid the developing countries should comply with the economic and political demands made by the creditors. Economic demands provide for all sorts of unilateral privileges ensuring a practically uninhibited exploitation of natural and manpower resources. This leads to a lopsided development of the national economies making them an appendage of the developed capitalist countries. As political retribution for its "aid", the West requires that the recipient countries should conduct a reactionary internal and external policy, offer their territories for the deployment of military bases and engage in aggressive undertakings against neighbouring states.

To top it all, in recent years this "aid" has become more costly in purely financial terms because the cost of credits along the "aid" lines is rising. In fact, a developing recipient country, as a rule, has to use the credit to buy goods and service in the developed donor-country usually at a high cost. Therefore, the terms of the so-called aid actually do not differ from the terms and conditions of costly private credits obtained on the free market.

Developed capitalist countries grant financial

aid to developing states both on a bilateral and multilateral basis, for instance, through such financial and credit establishments under their tight control as the International Monetary Fund (IMF), the International Bank for Reconstruction and Development (IBRD) and their affiliates. The IMF customarily grants short- and medium-term credits with repayment in five to seven years to offset their foreign deficits. Depending on the terms of the credits, the interest rate fluctuates now between 5 and 7 per cent. The IBRD grants medium- and long-term credits with their interest rates steadily rising. By now the rates have exceeded 10 per cent and are close to the market terms.

The IBRD and the IMF are fully controlled by developed capitalist countries and actively pursue their neo-colonialist policy. Let us examine, for example, the International Monetary Fund, an institution whose activities are regarded by bourgeois experts as one of the most efficient instruments of economic, scientific and technical aid to the developing countries. True, the IMF loans to newly-free countries, as all the finances received by the bank from imperialist states, stimulate to a certain extent business activity. However, at the same time these resources sharply aggravate and multiply socio-economic problems. By granting loans, the IMF simultaneously requests the recipient governments to

carry out such measures as the devaluation of national currencies, the liberalisation of monetary and import controls, the toughening of credit terms by raising the bank rates, higher taxes on the working people, a wage-freeze, etc. In a nutshell, the IMF spares no efforts to ease the free inflow of foreign investments and create favourable conditions for TNC activities in the developing countries.

For instance, when Mexico found itself on the brink of insolvency in August 1982, the IMF consented to "aid" it subject to its repealing or mitigating price controls, closing down 106 state-owned companies and agencies and freezing wages. The terms of a loan for Tanzania provided for a 50 to 60 per-cent devaluation of the local currency, a sharp rise in maize flour prices, flour being the staple food for most of the population, repeal of price controls, freeze of salaries and wages, and increase of the bank interest rates to 30-35 per cent.

Direct private investments are one of the most intricate spheres in relations between the TNCs and the developing countries. After gaining political independence many young states attempted to oust foreign capital. The adoptation by the OPEC countries in 1968 of a statement asserting the inalienable right of the countries to freely dispose of their natural resources, was a positive example in this respect. However, far from all de-

veloping countries are so successful in their relations with TNCs.

In this field, they face a very difficult problem because they cannot exercise effective control over the TNCs' activities. The unrestrained activities of foreign capital and the predatory exploitation of the developing countries' natural and manpower resources are extremely harmful to their economies. Over the past decade, US transnational corporations notable for their aggressive conduct have exported capital worth about $13 billion to Latin America and reaped profits to the tune of almost $22 billion. Over the same period they increased investments in African countries from $2.6 to $3.7 billion, or by 30 per cent and the aggregate sum of the profits pumped from the region has almost doubled, from $602 million to $1.3 billion. In 1980 the profit rate on US private investments in developed capitalist countries was 19 per cent, but in the developing countries as a group it was 27 per cent and in the developing countries of Asia where US capital acts particularly impudently, this rate reached almost 50 per cent. The aggregate profits on foreign private investments in the last decade were almost 120 per cent higher than the total amount invested in the developing countries.

Thus, the indiscriminate use of foreign capitalist resources by the developing countries not only

failed to produce the desired results in economic performance but created new problems and difficulties. As a result of costlier credits, in the early 1980s the outflow of capital from the developing countries outstripped the influx of capital turning these countries into net capital importers. For instance, in 1985 Zambia paid $19 million more to the IMF than it obtained. Corresponding figures were: for Uganda — $65 million; for Ethiopia — $31 million; for Tanzania — $5 million; for Madagascar — $4 million; for Sudan — $5 million; for Sierra Leone — $4 million; for Mauritania — $3 million. Combined with other concurrent unfavourable external factors, this undermines the economies of the developing nations and weakens their immunity to the negative impact of economic crises and, in a number of cases, increases their political and economic dependence on imperialist states.

Nobody entertains any doubts in the developing countries that this "aid" is a lever for enslaving African, Asian and Latin American countries and prompting them to embark on the road of "dependent" capitalism. In the developing world, TNCs promote the development and consolidation of capitalist relations of production, are instrumental in the formation of their social base, i.e. the local bourgeoisie, bureaucratic and technocratic groups. In other words, TNCs assist in creating their vital guarantees of the

capitalist orientation of the newly-free states.

In Third World countries imperialism instills Western standards of life and stimulates the emergence of new capitalist strata. In recent years, it transpired that imperialism was striving to create at mixed enterprises, specially in TNCs' branches, in the developing countries some priviledged layers of "workers' aristocracy" to serve as the basis of the national bourgeoisie and neo-colonialists.

This policy becomes particularly important for international imperialism in view of the fact that the peoples of the developing countries are more firmly rejecting the neo-colonialist division of labour offered to them. Imperialism spares no effort to keep these countries in the economic, scientific and technological backwoods, to maintain foreign monopolies' control over vital economic sectors, impose a non-equivalent trade exchange on these countries. In these conditions, bourgeois ideologists attempt to concoct even a theory of "predestination" explaining the scientific and technological retardation of Asian, African and Latin American countries, a theory in which the trite neo-colonialist motives are interwoven. However, if previously colonies and semi-colonies were regarded mostly as agrarian and raw-material appendages of metropolises today it is claimed that even if young national states can develop their industries to a certain extent,

still, on the whole, they have to inevitably remain on the outskirts of scientific and technological progress. It is exactly on these ideas that imperialism builds its policy.

As distinct from the capitalist countries, the socialist states establish their monetary and financial relations with the developing nations along the lines of mutually-beneficial cooperation and help expedite the attainment of economic and political independence by the young states. Socialist countries primarily grant commodity credits for investment. These credits are extended for more than 10 years with a grace period of three years and an interest rate not exceeding 3 per cent. Besides, as a rule, developing countries can repay credits either with the products manufactured at enterprises built on these credits or with their traditional exports. These practices expand the export base of young states, are beneficial to their balances of payment, do not incur the growth of external debts and are instrumental in the implementation of national economic development programmes. Thus, credit relations between socialist and developing countries differ from those imposed by capitalist states not only structurally but also in their economic content.

5. Information Aspects of Imperialism

Scientific and technological progress in the facilities for the transfer and processing of information creates new grounds for a confrontation of various countries, including the developed capitalist and developing countries, that is, the sphere of information relations. The rising struggle of the developing countries for their economic independence in the second half of the 1970s and the advancement of the programme for the establishment of a new international economic order, have affected the sphere of information, as well. Developing countries presented just demands to the developed capitalist states, primarily the USA. They accuse the latter of the establishment of a regime of "information dependence" or "information colonialism".

This policy is most pronounced in the mass media. Indeed, in the early 1980s the developing countries with more than 70 per cent of the world's population, accounted for only 20 per cent of the titles of published books, 17 per cent of the newspaper circulation, 5 per cent of TV stations, 12 per cent of TV sets and 18 per cent of radio sets. By using its dominant position in the mass media of the non-socialist world, imperialism attempts to impose its ideology, concepts and views of the situation in the world, different regions and countries.

In these conditions, it is becoming particularly important to establish a new international information order (NIIO), i. e. an equitable exchange of information within the framework of a worldwide mass media system and on the basis of democratic norms in international relations in the field of information. The task of creating a new international order in this field which is becoming increasingly urgent in modern conditions is necessitated, on the one hand, by the desire to eliminate the dependent position of the developing countries on capitalist states in this vital field and, on the other, by the need to use modern information facilities to promote peace and mutual understanding of nations. The establishment of a NIIO implies the need to regulate the flow of international information and attain at least a balanced exchange in this sphere. It also suggests the need to ensure legal protection from ideological subversion and imperialist expansion, the protection of, and the aid to, the national mass media systems, the strengthening of their material basis, etc.

The idea of a new international information order was sponsored by developing countries who do not possess developed mass-media systems and suffer most from the preponderance of capitalist information monopolies on the international scale. This idea won the support of socialist states. The struggle for the establishment of

a NIIO has an anti-imperialist character and is linked to the struggle for the restructuring of the entire system of international relations on an equitable basis.

To counter the concept of NIIO, the Western countries presented the concept of a "free flow of information" conceived as a bourgeois doctrine providing for the dissemination, without any legal or political restrictions, of informational and propaganda matter produced by the leading capitalist press, radio and TV concerns. The concept of a "free flow of information" was suggested by US ideologists and propagandists in order to whitewash the world-wide expansion of US press monopolies which constitutes undisguised interference in the internal affairs of other states and an attempt to impose imperialist ideology on the peoples.

However, despite the importance of this struggle it would be wrong to regard the struggle for the establishment of a new international information order exclusively as an effort to avoid the ideological and propagandist pressures exerted by the bourgeois mass media. The point is that it is also important to wage the struggle for a fair and full satisfaction of the developing countries' information needs in economic, scientific, technological and commercial fields. However, this aspect of the struggle for equality in the field of information remains, so to say, on the sidelines

which, incidentally does not diminish the significance of the problem.

Indeed, the successful operation of the economy and, consequently, the ability to tackle socio-economic problems, depend on such a vital factor for a nation as economic, scientific and technical information. By stressing the importance of the information potential and overstressing the significance of information, bourgeois ideologists strive to conceal the true goals of the capitalist countries in the field of information. In particular, they advance the postulate of the priority of the development of the information potential over the economic potential. In this connection, the information processes in the social, cultural and economic development which are based on electronics and computers are regarded as a cure-all for crises and social upheavals which can qualitatively change the standard of living in the developing countries without introducing any radical changes in social relations.

What really prevents the developing countries from resorting to this simple and unquestionable method for overcoming their backwardness? Indeed, many take radical steps aimed at introducing information technologies and techniques in many social spheres. Moreover, in recent years developed capitalist countries have been displaying a keener interest in the export of modern in-

formation technologies to the developing countries.

However, everything is not that simple. The production, introduction and use of the achievements in microelectronics, information and communication technologies is impeded in the developing countries by their relatively low level of development of industry, services and the telecommunications structure. It is also hindered by a low level of information supply and the inability to reconcile the traditional stereotypes in thinking and behaviour with the demands and conditions engendered by the production and use of microelectronics and information technologies. There are also other serious obstacles such as a restricted home market of the developing countries, a lack of specialists and a relatively high level of the R&D-related expenditures.

Still, the developing countries cannot offhand reject the use of the latest technologies in the field of information because otherwise it would further deepen the technological and social gap and exacerbate their scientific, technological and social backwardness. That is why in their attempts to tackle the difficult tasks of eliminating their centuries-old backwardness, most of the developing countries have to borrow from capitalist countries their financial and material resources, scientific knowledge, technical know-how and experi-

ence in running production. All this immediately involves the developing countries in the world capitalist economy. This, in turn, engenders all contradictions as a consequence of the unfavourable conditions of technology transfer and the granting of services, contradictions also caused by the TNC's policies, crisis phenomena in the world capitalist economy, etc.

The involvement of economically less-developed countries in computerisation and the development of communication technologies, offers promises of a number of political and economic advantages to international capital. The introduction and use of information and computer technologies in developing countries bring, as a rule, rather modest results because the companies which have cornered the developing countries' markets are interested primarily in deriving maximum profits rather than in resolving the vital problems besieging these countries. The world superiority in the production of electronic instruments and computers attained by several big companies, with US companies holding six top positions, increases the dependence of developing countries in the sphere of electronic data processing means. About 90 per cent of the pool of universal computers used by the developing countries are North American products with the IBM accounting for 63.3 per cent.

Because the developing countries lack trained and high-skilled personnel for introducing and operating information devices and computers, as well as the absence of programmes specially designed for this purpose, the TNCs can easily sell them outdated or second-hand machines. Quite often sophisticated machines are used not for their intended purposes but to solve problems which can be tackled by less sophisticated and less expensive equipment. Specialists cite an example of a computer for traffic regulation in a big city being installed in a small rural community. The criteria of technical obsolescence of equipment applied in the developed countries are mindlessly transferred to the developing countries inducing the latter to unreasonably replace or improve that equipment thereby substantially raising capital investments. One of the Persian Gulf states has three times replaced its computer pool and eight times expanded it in less than seven years.

In many instances, the reasons for the low efficiency of the application of modern computers are a rather poor idea on the part of their buyers and users as regards their potential and the ensuing costs of repairs and maintenance, a weak interaction between various services having access to computers and the malfunctioning of the energy supply system. To rectify the situation, young states frequently have to resort to the serv-

ices of foreign specialists. As a result, information technology becomes not only a technological resource but a political factor as well.

In examining in detail the idea of the transfer of modern information technologies to developing countries, a Canadian expert, T. McFile, characterised this process as "electronic colonialism". The staff supervising the functioning of imported computers is aptly called by the author "an integral instrument of cultural imperialism" because it brings them such values, concepts and professional methods of managing communications systems, which can fail to correspond to the ideas and intentions of the developing countries in the area of applying information technology.

Inequality and dependence in this field are exacerbated by high costs involved in the creation and maintenance of modern information systems. This precludes the creation of their own facilities for collection, transfer and storage of information in the developing countries. In these circumstances, the latter resort to information services supplied by developed capitalist countries.On the one hand, the rapid development of information technology and transborder flows facilitate the solution of difficult problems arising in the most diverse spheres in the developing countries and, on the other, engender new forms of dependence.

Developed capitalist countries not only trans-

form the transborder flow of data into a commodity bringing huge profits but also into a most powerful instrument of control, supervision, political and economic pressure and blackmail which make the developing countries still more dependent. With the production of the information equipment, computers and auxiliary equipment concentrated in their hands the industrialised capitalist countries and their transnational corporations control the receipt, processing, transfer and distribution of information, while the developing countries mostly supply data and buy processed information. In supplying the most diverse data, the developing countries often are not even aware of their potential economic, political or social value which becomes clear only after their informational processing. Moreover, since the developing countries lack the system of information collection and storage facilities, they have often than not to buy from developed states the information which they themselves initially put into the system.

Today, transborder information flows are extensively used in weather forecasting and civil aviation. Technical innovations of the last three decades, space and aviation technologies, new systems of data processing and telecommunications systems, have markedly improved weather forecasting. In their weather reports, developing countries increasingly rely on the data supplied

by developed states. Remote sensing satellite systems with high resolution can collect substantial volumes of information on natural resources, crop-yield prospects, climate, etc. (Exceeding the volume of information possessed by the developing countries themselves.) The data collected by communications satellite systems and remote sensing systems, besides their strategic value, are, undoubtedly, also of commercial value. Developing countries are also dependent on capitalist states in the field of information for airtraffic.

To wage a consistent struggle against neocolonialism in the field of international information relations, it is necessary to elaborate a strategy of struggle against "information imperialism". Some developing countries advocating a more equitable and fair exchange and use of information and the development of information technologies, are elaborating their own policy in this field, a policy resisted by the TNCs. For example, in the late 1970s the government of India decreed that any transnational corporation could use the information resources of the country only on the basis of equitable cooperation with an Indian company. Brazil decided to supervise the production, purchases and use of computer facilities. Thus, the developing countries, aware of the threat posed by "cultural information imperialism", advocate relations with the developed capitalist countries which would

provide them with certain safeguards against the TNCs dictate. The developing nations' struggle for the democratisation of relations in the field of information meet with support and assistance of the socialist countries and international organisations.

Thus, information systems and technologies exist within the framework of concrete relations, economies, history and policies pursued by the countries, rather than in the void. Almost four decades of the rapid expansion of computer and information technologies have clearly showed that these technologies alone cannot create a "new future" which the advocates of informatisation present as a cure-all for all sorts of social problems, including the backwardness of the developing countries. A well-known US scientist Herbert I. Schiller wrote in his *The Mind Managers* (Boston, Beacon Press, 1972, p. 185): "The suggestion that the data-rich society and its supportive hardware will dissolve our current social ills is both cruel and deceitful. It is cruel to suggest that ghetto children confronting computer consoles will magically overcome generations of deprivation. It is deceitful to allow preoccupation with electronic technology and technique to obscure the institutional underpinnings that continue to be responsible for the direction and focus of the new instrumentation.

The central questions concerning the charac-

ter of and prospects for the new information technology are our familiar criteria: *for whose benefit and under whose control will it be implemented?*"

6. What Scientific and Technological Policy Do the Developing Countries Need?

For the newly-free states the attainment of economic independence is inseparable from their struggle for scientific and technological independence. Therefore, the elaboration and persistent implementation of a long-term purposeful policy in science and technology is of great importance in overcoming their socio-economic backwardness. It is necessary to elaborate this special policy because the developing countries have to be drawn into scientific and technological progress in difficult conditions. It is a process seriously impeded, as we have seen, by several factors engendered by a number of inter-related internal and external conditions. The scientific and technological policy of these countries should create prerequisites for the gradual elimination of obstacles and difficulties encountered in the development of their own scientific and technological potential.

The objective need for the most expedient elaboration of an appropriate scientific and techno-

logical policy is also explained by the need to eliminate the economic backwardness of the newly-free states especially in view of their struggle against economic neo-colonialism and, in particular, their "technological exploitation" by international monopolies. The STR problem in the developing world is aggravated by the unresolved problems of the industrial revolution. The scientific and technological policy is aimed at expediting their solution.

Thus, the complexity and comprehensiveness of the problems involved in the scientific and technological development of young national states, urgently calls for a special policy in this field and necessitates the expansion of their scientific and technological potential. The scientific and technological policy is expected to resolve the contradiction between the objective need of using the breakthroughs in science and technology and the developing countries' limited opportunities in this area. The scientific and technological policy is an important element of every developing country's overall task of overcoming its backwardness.

In the years immediately following the gaining of political independence, most of the developing countries had no policy in science and technology to speak of. Subsequently, they began to establish gradually a system for regulating development in this field although, with rare excep-

tions, this policy boiled down to individual, uncoordinated measures to implement specific technical development programmes or involved the contractual transfer of technology.

The 1970s and the early 1980s were a period when the developing countries intensified their efforts to elaborate and improve their policy in the field of science and technology. By now, this process has embraced a greater number of countries although its intensity and the degree of maturity substantially differs in individual countries. Some countries (India, Mexico, Algeria and others), for quite some time have been accumulating experience in the development of their scientific and technological potential. The scientific and technological policy of these states is becoming increasingly comprehensive and an integral part of the strategy for the national socio-economic development. This policy is linked to the national economic plans and investment programmes and is evolving into a long-range course for a period of 15 to 20 years. However, even this limited group of countries faces the most serious problems in respect to improving scientific and technological policy and making it more fruitful.

Many developing countries, however, are taking just the first steps in its elaboration. Despite some differences in their socio-economic development, Asian, African and Latin American coun-

tries pursue scientific and technological policies which have many features in common. Their policies are aimed at eliminating their dependence on imperialism, attaining independence in this field and creating internal and external conditions for scientific and technological progress.

The attainment of these general, promising goals can be ensured by a system of stage-by-stage measures in managing, organising and coordinating the development of science and technology. This presupposes the tackling of many problems including the elaboration of plans for the development of science and technology; the identification of basic scientific and technological priorities; the consolidation of all elements of the scientific and technological potential in their organic pattern; personnel training; the establishment of scientific infrastructure; R&D financing; the establishment of science-management bodies; and the creation of a mechanism linking science with production.

In the 1980s, the developing countries are devoting considerable attention to the elaboration of basic principles underlying the national policy in science and technology. These basic principles are: scientific and technological independence of the country; integration of scientific and technical activities, on the one hand, and economic, social and cultural goals of development, on the other; a balanced combination of two integral as-

pects of the scientific and technological policy — a policy of assimilating new knowledge and its more effective application; use of scientific and technological achievements for peaceful purposes; development of international cooperation in science and technology.

State leaders and economists in newly-free countries are becoming increasingly aware of the need to organically combine the scientific and technological policy with the comprehensive economic policy. The former should be elaborated considering the real needs and opportunities of a particular country, i. e. it should be a scientifically-substantiated policy. A major principle in any scientific and technological policy should be the combination of long-term and short-term objectives and the correction of strategic goals taking into consideration any changes in the immediate goals in the course of their attainment or the emergence of new requirements and needs. It is also necessary to stress the significance of such principles as the practical orientation of science, concentration upon the key fields of activity and state supervision of science and technology.

The scientific and technological policy cannot be carried out without the establishment of a corresponding infrastructure, i. e. a system of national organs and establishments responsible for the implementation of this policy. For example, India has a sufficiently diversified system for

supervising its policy in science and technology. The National Committee for Scientific and Industrial Development identifies basic trends in the country's scientific and technological policy. There also exist bodies coordinating the development of the major research sectors: the Department of Atomic Energy, the Department of Space Research, the Council of Agricultural Research, the Council of Medical Research and the Council of Geological Research. However, it should be noted that this system has been established in many developing countries only recently. In some developing countries such institutions are only at the planning stage.

It should be also noted that to be an efficient managerial instrument, plans in science and technology must be comprehensive and envelop the basic trends of the scientific and technological potential.

Since the scientific and technological revolution is taking place within the context of the competition between the two systems exerting a radically different influence on the social, economic and political processes unfolding in the developing countries, the choice of the right political alternative leading to scientific and technological independence is made under difficult conditions. This situation generates the struggle between the two main trends: one towards independent development linked internationally with the expan-

sion of the all-round cooperation of the newly-free states with socialist countries, and the trend towards the dependent development of the former, the trend which imperialism is interested in promoting.

The mutually-beneficial economic, scientific and technological cooperation between socialist and developing countries is reflected in the steadily growing reciprocal trade, the expansion of personnel training programmes, the transfer of technology and scientific and industrial experience, joint R&D projects and expanding cooperation in other fields. The Comprehensive Programme of Scientific and Technological Progress of the CMEA Member-Countries Until the Year 2000 stresses that these countries will continue to render scientific and technological assistance to the developing countries with the aim of consolidating their national economies and strengthening their national independence.

As cooperation between socialist and developing countries expands and deepens, it will increasingly become an effective factor for the elimination of the newly-free countries' economic backwardness and a factor contributing to the eradication of the pernicious consequence of colonialism and neo-colonialism, to the successful implementation of the scientific and technological policy aimed at overcoming their backwardness and facilitating independent development.

Chapter Six THE STR AND MODERN GLOBAL PROBLEMS

With every passing year, the rapid development of scientific and technological progress exerts a more profound influence on the modern world. Today, we clearly see the inexhaustible opportunities inherent in the scientific and technological achievements. At the same time, we more clearly see dangerous phenomena threatening mankind's future, the phenomena associated with the specific nature of the initial stage of the scientific and technological revolution and its progress in conditions of the competition of the two social world systems.

Mankind is on the threshold of

the 21st century. However at this juncture we more often speak with greater apprehension of a number of the so-called global problems. What are these problems and why do they draw such attention and provoke such heated debates and discussions? Usually we relegate to the realm of global problems those linked to the question of war and peace, the elimination of economic and social disparities between the developed and developing countries, energy and food resources, the threat of catastrophic environmental pollution and the negative consequences of the STR.

What common features do they share? Indeed, at first glance they seem quite different and unrelated. At the same time, beginning with the late 1960s, they were all characterised as "global". The point is that despite their surface dissimilarity, different nature and specific origin of individual problems, they have much in common.

Indeed, in one way or another, all are associated with the activities of man and influence his development both on a global scale and within the main regions. Indeed, what is the link between the problems concerning Europeans and those encountered by their counterparts in Africa? Let us examine the problem of war and peace. The stormy centuries of wars and military

conflicts in the history of Europe practically bypassed the African continent. However, today the situation has radically changed. There are no countries, regions or nations whose very existence does not depend on the solution of the problem of war and peace. Even a local military conflict may evolve into a global nuclear war threatening the annihilation of all humankind, a war which will spare neither inhabitants of big European cities, nor Tuaregs crossing the Sahara or Australian aborigines.

Is it possible that all our fears are exaggerated and we can hope that in the future all these problems will simply vanish? The global problems are such that all are urgent and if unsolved and pending for a long time, they threaten to undermine the very foundations of humankind's existence. It is not by chance that we hear more often of the danger of ecological disaster, the depletion of energy, mineral and food resources, problems which are becoming more difficult to solve with every passing year. If we delay the solution of the problem of war and peace nuclear war can supply a simplistic solution to all problems: it will just kill life on Earth.

Finally, to solve all these problems, it is imperative to establish stable cooperation between all countries, irrespective of their social systems, and to reliably coordinate the efforts of mankind. For instance, as the experience of international co-

operation reveals the problem of eliminating the socio-economic backwardness of the developing countries cannot be solved only through the efforts of this group of states. It requires the aid and concerted efforts of all nations.

STR: Friend or Foe?

What is the source of global problems? Are they eternal and too intricate? From the outset, it should be noted that the term "global problems" has gained common currency. However, bourgeois scientists and Marxists differ in their approach to the origins of the problems, infusing them with a different social, economic, political and ideological content. Moreover, they are at variance in their interpretations. Bourgeois scientists and political leaders ignore or belittle the socio-economic background of the global problems in an effort to make them appear to be problems totally divorced from the class struggle or ideology. Indeed, the complex problems of war and peace, ecological, demographic and other problems have to be tackled together by all countries, socialist, capitalist and developing alike.

Still, Marxists maintain that these most complex problems require common efforts of all nations in the interests of mankind. Socialist coun-

tries and the overwhelming majority of the developing states, as well as popular and democratic movements the world over, spare no effort to resolve the global problems and, first and foremost, the problem of averting a nuclear war. However, their efforts meet with a stubborn resistance on the part of imperialists states, their ruling circles and the military-industrial complex. Here it is in order to mention the selfish aspirations of transnational corporations bent on maintaining the existing unequal economic relations between the capitalist and developing countries. We should also note the corporations' drive for superprofits or transient advantages to the detriment of mankind's long-term goals.

Let us return to the crucial issue. What are the origins of the global problems and how should they be dealt with? In one way or another, all global problems are related to scientific and technological problems. The most sophisticated modern weapons of mass destruction are a by-product of breakthroughs in science and technology with the latter making it possible to raise industrial production and promote other economic activities. As a result, mankind is facing the threat of depleting natural resources: energy, ore, minerals, timber. Industrial plants and automobiles pollute the environment. Industrial wastes pollute rivers and lakes and kill animals, birds, fish and insects, with water organisms vanishing

forever. Tremendous forest areas are wiped off the Earth. Man-made hydraulic power stations and water reservoirs harm Nature and lead to undesirable changes in the landscape and climate, as well as alter the water balance. There are quite a few examples of the negative impact on Nature by man in the process of exploiting the achievements of STR. That is why bourgeois researchers would rather believe that these and other problems are rooted in the very nature of man who in his senseless drive attempts to conquer Nature, subjugate other people and haphazardly manipulates scientific and technological progress to these ends.

Of course, there is a grain of truth to these allegations. Man has to foresee not only the immediate but also long range results of his activities. However, the results of these efforts quite often fall short of the mark. In making use of the latest achievements of science and technology and tackling other vital problems people engender other problems whose solution presents even greater difficulties. For instance, increasing fertility of soil leads to the massive runoff of fertiliser into streams, rivers and lakes, and to the infection of underground water. Sometimes problems arise whose solution is practically impossible at the present stage of civilisation. For example, there is the problem of radioactive wastes which are a by-product of peaceful uses of the nuclear

energy, to say nothing of the consequences of unforeseen break-downs in this field.

One should recall that already today scientific and technological progress is instrumental in eliminating or diminishing the risks associated with many global problems. Foodstuffs produced in the world would seem to be enough to eliminate starvation not only in the industrialised but in the developing countries as well. If we manage to resolve the basic problem of war and peace and channel just a part of the resources allocated for war preparations into agriculture there would be no food problem. It would also be possible to overcome the socio-economic backwardness of former colonies and semi-colonies. Science and technology offer many alternatives for substituting man-made products for natural materials. Reforestation is on the agenda, and there are quite a few examples of the preservation and even restoration of the stock of wild animals who were on the brink of extinction. Now is the time to take these and other steps or else it may be too late.

2. Global Problems

How are we to tackle global problems? What frustrates our efforts? What is to be done to eradicate their basic causes? Of course, in principle,

mankind encountered problems which subsequently grew to global proportions at the dawn of human civilisation. Already, at that time it had to strive to resolve them. Already in antiquity people fought each other. Farmers and cattle-breeders, ancient people left behind them waste land. They burned down tremendous forest areas and destroyed a huge number of wild animals. From this viewpoint we can regard the modern global problems as a by-product of previous global historic processes with all their inherent internal contradictions.

However, all these more or less local and regional problems today have assumed global proportions. Nevertheless, this situation should be not oversimplified, i. e. we should not regard the global problems as traditional contradictions, crises and calamities which have acquired global dimensions. On the contrary, these problems are the result of our epoch, a consequence of the extremely uneven socio-economic, scientific and technological progress and the result of the deepening internationalisation of the increasingly more intricate but interconnected and interdependent world community.

Thus, the global scope of these problems is not connected with the fact that we have to face them in all parts of the world and not with "human nature" as is asserted by bourgeois ideologists. Since global problems are primarily engen-

dered by social antagonisms they can be resolved by eradicating these antagonisms.

The anarchy of capitalist production causes society to produce goods which bring the highest profits to the capitalists rather than vital necessities. Hence, the predatory treatment of Nature and the heavy disruption of the ecological equilibrium. Suffice it to recall the tragedy of Bhopal in India when several thousand people died because of the Union Carbide's "economising" on purification installations. Such break-downs caused not so much by technical mishaps but by the owners' efforts to reap the highest profits by cutting down unprofitable expenses, have become ordinary occurrences in developing and industrialised capitalist countries. Particularly harmful are the activities of transnational corporations which, in their drive for maximum profits, locate ecologically-dangerous lines of production in developing countries lacking, as a rule, technical facilities for monitoring the environment and strict technological and legal standards establishing ecologically-admissible limits on production activities.

Finally, the economic and social backwardness of the developing countries, the legacy of colonialism, cannot be eradicated unless inequitable economic relations between the imperialist and developing states are eliminated. Nevertheless, the struggle waged by the latter for the establish-

ment of a new international economic order encounters the fierce resistance of the capitalist countries.

Socialist countries appeal to other states to resolve the global problems because they believe it is possible even now, with the world divided into different socio-economic systems, to find at least a partial solution to these problems. Interstate cooperation and the concerted efforts of communists and representatives of mass democratic, including pacifist, ecological and other movements, play an important role in tackling global problems. Here, of particular significance is the democratic struggle for peaceful coexistence and detente, against the neo-colonialist policy of state-monopoly capital, for mutually-beneficial international cooperation and a new international economic order in relations between the developed and developing countries.

3. "Nuclear Winter"

The vital problem of today is to prevent a nuclear war. Life on Earth and the survival of humankind depend on our ability to resolve this problem. Nuclear war is a totally new phenomenon in history. It is estimated that since 1945 more than 90 states have waged at least 150 wars on the territories of 80 countries with the loss of

20.7 million lives. Historians have calculated that about nine-tenths of the no longer existing states perished in armed conflicts. However, whereas in the past wars were fought to defeat the enemy, today there will be no winners in a nuclear war because global nuclear war spells the eclipse of civilization and life.

However, not all hold this view. In the USA, there are some proponents of a "preventive nuclear strike", a "limited or local" and "rational" nuclear war. These concepts are based on the assumption that it is possible to keep a nuclear war under control and win it. The protagonists of this idea are prepared to accept local and transient consequences of a nuclear conflict. Moreover, insane as it may seem, some scientists and political leaders regard war as an acceptable means in conflict situations. They allege that by exterminating some of the people a nuclear war will eliminate some of the problems, and the rest of the people will live happily thereafter as they did before the war.

The misanthropic nature of these concepts is clear. Indeed, Soviet and US scientists have estimated that a war in which ten to twenty thousand megatons would be exploded, would wipe out two to two and a half billion people or, at least, 62 per cent of the world population. Besides the immediate effects of a nuclear war such as the shock wave, heat and light radiation, primary

and secondary radiation and radio-active fall-outs there will ensue aftereffects of the primary factors: epidemics, fires, environmental changes. And the attending long-range consequences of nuclear war exceed by far the immediate effects of nuclear strikes.

At a conference, "Scientists for the Deliverance of Mankind from the Threat of Nuclear War, for Disarmament and Peace", held in Moscow in 1983 and at a conference "The World After Nuclear War", held in Washington the same year, the participants noted that the use of nuclear weapons would radically change the climate triggering off a global cataclysm. Nuclear strikes will cause fires emitting combustible products. Clouds of tiny soot particles will absorb and diffuse sunlight blanketing the Earth with "nuclear night". As a result, in a few days, the temperature on the surface of the Earth will drop by 30 to 50° C compared to the normal seasonably-adjusted temperatures. In just a few weeks, a radically-changed air circulation will engulf the rest of the world. Flora and fauna will be doomed to death. Even if some survive a nuclear war hiding in a shelter, they will see the Earth frozen to death in "nuclear winter". Hence, the conclusion: anyone instigating a nuclear war commits suicide.

Scientific research shows that besides a sharp drop in temperature, those who survive a nuclear

attack will be afflicted by the lack of drinkable water, the lack of food supplies and fuel, a high radiation level, pollution and diseases. These catastrophic effects will kill even those who survive a nuclear war. All peace-loving forces are against nuclear war which could exterminate mankind. It is necessary to repudiate nuclear weapons and stop their production as is provided for by the Soviet plan of a stage-by-stage elimination of nuclear weapons by the year 2000.

Let us recall the recent tragedy of Chernobyl. This disaster has made people realise that just a mishap at a nuclear-power station, not an A-bomb explosion, already poses an unprecedented menace.

Indeed, that was a misfortune which befell just one nuclear-power plant out of the dozens built in the world. Many people realised that to perish one does not need a nuclear war: it would be enough to strike civilian nuclear installations with conventional weapons.

However, even in conditions of peace, military preparations, development and testing of new weapons, and military manoeuvres adversely affect civilization. The arms race is unacceptable as an instrument for reaching foreign-policy goals or ensuring national security. It is also unacceptable in economic terms because of the high costs to humanity. Mankind does not want, and cannot reconcile itself to the fact that trillions of

dollars are squandered annually on producing and perfecting weapons instead of being channelled to fight the dire poverty in which two-thirds of the world population live.

The present level of military production jeopardises not only mankind's survival. Even with the absence of war, it is hardly feasible to ensure further progress since the expenses involved in the arms race are comparable to the material damage inflicted by world wars. Tremendous sums of money spent on armaments go down the drain. The diversion of productive forces to military purposes holds back social development. One cannot combine the arms race and an all-round socio-economic progress. Higher military expenditures entail reduced allocations for social needs such as health care, education and environmental protection.

In these conditions, is it surprising that military expenditures have already reached the trillion-dollar mark? Today, the level of military expenditures is four to five times greater than right after the Second World War and more than 25 times the official aid to the developing countries.The newly-free states themselves spend more money for military purposes than they get for their economic development. The sums alone spent on imported weapons would suffice to serve a quarter of their external debt (a trillion dollars) becoming a drain also on their economies. These

countries have about fifteen million men under arms, i. e. more than in the developed states, while the share of the Third World in global military expenditures has risen to 17 per cent outstripping by far their share in world industrial production.

Since the early 1980s the growth of military expenditures has been considerably higher than that of world production.

The arms race diverts tremendous material, manpower and scientific resources. Huge areas of land are used for military purposes. Estimates show that about 1.3 per cent of the land in Western Europe and USA is used to these ends. Military manoeuvres and tests damage the environment: the topsoil is destroyed, forests are devastated. The war industry consumes more aluminium, copper, nickel and platinum than is needed by the African, Asian and Latin American countries combined. In 1981, more than 50 million people, or more than 4 per cent of the gainfully-employed population, produced arms or served in the army. Tremendous inputs of mineral, ecological, material and manpower resources are totally unjustified because the global problems such as the rational use of natural resources, the provision of energy, the elimination of hunger and dangerous diseases, environmental protection, require strenuous efforts and the mobilisation of all resources at mankind's disposal.

It is clear that the solution of global problems is closely linked to the struggle for peace, peaceful coexistence and total disarmament. Indeed, it took only a sum covering the arms race for three hours to do away with smallpox. The money spent on the arms race in half a day would suffice to eliminate malaria, trachoma and leprosy, while 10 per cent would be enough to eliminate poverty throughout the world. It is easy to imagine what tremendous resources badly needed for its development, would be available to mankind if it rids itself of the costly arms production. As Dwight Eisenhower, US President in 1952-1960, noted "every gun that is made, every warship launched, every rocket fired, signifies, in a final sense, a *theft* from those who hunger and are not fed, from those who are cold and are not clothed".[1]

Each step and every measure intended to limit and reduce armaments will not only ensure greater security but make it possible to allocate more money for the improvement of living conditions. Indeed, if we combine the resources the USA has spent or plans to spend for military purposes for the 1950-1990 period, it would be possible with this amount to buy all the US possesses right now: houses, plants, highways, cars, trains,

[1] See: *Disarmament and World Development*, Ed. by R. Jolly, Pergamon Press, New York, 1978, p. 3.

planes, etc. That is why socialist and non-aligned countries and all peace-loving forces believe that a halt to the arms race and the reduction armaments constitute an indispensable prerequisite for resolving the exacerbating global problems.

A major step in this direction is the peaceful initiative advanced in 1987 by the Warsaw Treaty states contained in their statement "On the Military Doctrine of the Warsaw Treaty States". This move is based on the new way of thinking, a fresh approach to the problem of war and peace, disarmament and other intricate global and regional problems. It is based on the need to renounce the concept of nuclear deterrence. The military doctrine of the countries of the socialist community pursues the goal of averting nuclear and conventional wars. It is defensive and based on the need to maintain the balance of military forces on the lowest level possible and to reduce military potentials to the levels sufficient for defense. The aim of this initiative is not only to safeguard peace but also to restructure the world so as to avert war. The threat of annihilation compels mankind to deal with this task of attaining peace not interrupted by wars and a just peace for all nations. The striving for peace and the inherent desire of mankind to ensure its own survival must be translated into a reliable system of international security.

4. Is Nature Threatened with Annihilation?

Man lives and develops in a certain habitat, in an interaction with Nature. In this process, mankind resorts to increasingly more potent technical means to make more intensive use of natural resources with the eventual goal of improving conditions for the development of civilization. However, by "conquering" Nature mankind has substantially undermined the natural foundations of its activities. As a result of the scientific and technological progress and the rapid growth of world industrial production, the interaction between society and Nature, man and his habitat, has enormously intensified. The ecological problem has reached such dangerous proportions that now at stake is mankind's survival because of the lack of natural resources and the dangerous pollution of the habitat.

The report by the World Commission on the Environment entitled "Our Common Future", which was submitted to the 42nd General Assembly Session, noted that recently mankind had achieved a number of positive results. It pointed out that there were some hopeful signs: infant mortality was declining; the average life expectancy was being extended; the share of literate adults was growing in all countries; the share of children attending school was increasing; the rates of food production were higher than the

rates of population growth. The report stated, however, that the processes making possible these hopeful signs had engendered trends which the planet or the population could not long endure.

The environment reveals dangerous symptoms which can radically change the face of the planet and endanger many animal species, including the human race. Every year six million hectares of fertile soil become barren deserts. In three decades, this will approximately equal the size of Saudi Arabia. More than eleven million hectares of forests are destroyed annually and in three decades the deforestated area will almost equal the territory of India. A substantial area of former forests is transformed into low-grade arable land which cannot feed even the farmers living there. The combustion of mineral fuel produces carbon dioxide, a process gradually warming the world climate. As a result of this "hothouse effect", by the next century the average global temperature may rise to the level which will radically change the geographical pattern of agricultural production. As a result of the melting of polar ice, seas may flood costal urban areas, most seriously damaging the economies of all countries. Other industrial gases may harm the ozone layer of the Earth thus increasing the incidence of cancer among people and animals. Toxic industrial substances will increasingly penetrate the

digestive tract of man and infect underground water to the levels rendering its purification impossible.

Let us cite some figures and facts demonstrating the impact of human activities on the environment. Over the last century, mankind has increased its energy consumption a thousand-fold. The aggregate volume of goods and services in the industrialised countries is doubled every fifteen years. We see a corresponding growth in the wastes polluting and poisoning the atmosphere, water and soil. In the industrially advanced countries, the per capita mineral extraction is about 30 tons of which only 1-1.5 per cent is consumed, the rest being wastes, often harmful to Nature as a whole. Many non-renewable natural resources are on the brink of depletion and the deposits of conventional fuel are rapidly being depleted. The global pollution of the biosphere is sharply rising.

The so-called acid rains have become the scourge of humanity. Penetrating water reservoirs, harmful fall-outs destroy practically everything living, from fish to microorganisms and verdure. These rains ruin everything made by man: buildings, watermains and cars. The sources of this evil are thermal power plants, industrial boiler-houses and motor vehicles polluting the air with sulphurous anhydride and nitric oxides. After complex chemical reactions

they are transformed into sulphuric and nitric acids which fall out as rain, snow or mist. Sometimes this occurs hundreds of miles away from the producer of the poisonous pollutants.

Acid rains destroy not only forests and waterpools, they also destroy monuments of culture. In Rome and other European capitals, sculptures and friezes created by great artists of the past have been literally corroded to the bone by poisonous fall-outs. Many species of animals and plants have disappeared recently as a result of human activities. Equally disturbing is the unrelenting disappearance of the habitat of other species. It is a tragic fact that over the last 500 years man has destroyed two-thirds of the forests previously covering the Earth.

Some theoreticians in the West regard the deteriorating ecological problem as an impending global cataclysm which, they allege, is threatening all countries irrespective of their social systems. They associate this crisis exclusively with industrial growth and the scientific and technological revolution, i. e. mainly with the technological aspect of the interaction between man and Nature.

Indeed, the last decades witnessing the scientific and technological revolution not only have radically changed productive forces but sharply exacerbated the ecological problem and raised the question of the ability of Nature to cope with

the unpredictable consequences of human activities.

All this poses a number of questions: must scientific and technological progress and its consequences destroy environment, deplete natural resources and lead to the deterioration of living conditions? Or are all these consequences have their source in particular methods and forms of influencing nature and the forms of applying the achievements of scientific and technological progress endemic to a particular social system determining trends in the development of science and technology, all productive forces and, consequently, the forms and methods of influencing Nature?

The dialectically contradictory unity and the interaction of society and man, man and the environment are ensured by material production. Marx wrote: "Labour is, in the first place, a process, in which both man and Nature participate, and in which man of his own accord starts, regulates, and controls the material reactions between himself and Nature".[1] It is this interaction which ensures the unity of man and Nature and the transformation of Nature to suit human needs. It makes it possible to create a "second Nature", an artificial habitat conditioned by

[1] Karl Marx, *Capital*, Vol. I, Progress Publishers, Moscow, 1984, p. 173.

man's culture and social organisation.

In time, by developing production, i. e. by mastering Nature and subjugating it, man has increasingly upset the innate balance of its components. Initially, Nature could cope with these encroachments and restored the "order" violated by man. On the one hand, it was the result of the underdevelopment of man himself and imperfect tools he applied and, on the other, it was a consequence of underdeveloped social relations. Indeed, by producing primitive instruments and tools of labour man could appropriate only such means of subsistence which were made available by Nature, i. e. man only gathered that which was growing by itself, or he was engaged in hunting and fishing. These activities had only minor impact on the balance in Nature, and the balance could be restored all "by itself". In turn, the social heterogeneity of that society which knew no classes, social groups and strata, or the exploitation of some groups by the others, engendered no conditions favouring a wasteful use of natural resources detrimental to nature and, in the final analysis, harmful to the man himself.

The transition of mankind from nomadic cattle-breeding to settled life and farming, i. e. from a consumer society to production, made productive forces much more sophisticated and radically changed their essence and forms. Man's ac-

tivities based on private property grossly violated the inner balance in Nature and led to such acute imbalances and conflicts that there often emerged crises and, at times, catastrophic situations. As Marx stressed: "... Cultivation when it progresses spontaneously and is not *consciously controlled* ... leaves deserts behind it".[1]

There can be different causes for the above crisis situations. However, there were present two underlying factors: the development of social production and productive forces and their social background, i. e. social relations based on private property. As he conquered nature man obtained what he wanted but simultaneously triggered off unpredictable consequences which nullified the victories he scored. Ancient History, the Middle Ages, the Industrial Revolution, and especially the present scientific and technological progress involving practically all known both renewable and not replenishable resources of the Earth serve many examples to this effect. Actually, we now face profound contradictions between Nature and society which are becoming increasingly antagonistic under capitalism and erupt into painful and dangerous crises. By itself, nature no longer can cope with this damage. However, does it

[1] "Marx to Engels in Manchester, March 25, 1868," in: Marx/Engels, *Selected Correspondence*, Progress Publishers, Moscow, 1982, p. 190.

follow that all these situations are engendered by civilisation, and by the STR in particular?

Of course, it is true that the development of civilisation produces collisions between man and society as a whole with the rest of Nature. However, there is no fatal inevitability of the development of these conflicts. They can be resolved provided that mankind cognises the laws of nature and brings its activities into line with them and when it takes into account and foresees the consequences of its actions. Now, as a result of the scientific and technological revolution, mankind possesses an unprecedented scientific and technological potential making it possible to avert or timely rectify the disturbance of the equilibrium of Nature.

However, it is not enough to have the necessary prerequisites for solving the problems arising in man-Nature relations. Society also needs certain conditions which would enable a rational use of nature taking into account these prerequisites. However, the prevalence of private property relations does not create such prerequisites. Moreover, the exacerbation of global problems and the deteriorating interaction of Nature and society, exposes a limited social character of the capitalist system which becomes more evident as society develops scientifically and technologically.

Many participants in the movement for the

protection of the environment and consumers from the ill-intentioned use of scientific and technological achievements subscribe to the conclusions drawn by an US ecologist B. Commoner. He wrote that tracing to the source of any environmental problem leads to the incontestable truth: the main reason for a crisis lies not in the relationship between people and Nature but in relations of people themselves; peace between people and Nature is preceded by peace between people. Indeed, as we have already stressed, the scientific and technological progress opens wide prospects for the development of human community, but it would be wrong to overlook the difficulties caused by environmental pollution, the depletion of non-renewable resources, the shrinking of the energy base, etc. To solve these problems it is necessary to elaborate a scientific strategy of the development of human community. It also requires much effort by the community as a whole and depends on its organisation and the ability of every member of it to make a tangible contribution to the solution of global problems.

There is a rising world movement for environmental protection, and mankind is becoming increasingly aware of the need for an effective international cooperation in the field of ecology. For example, one may hope that the "air of Europe" threatened by particularly acute ecologi-

cal problems, will be cleaner in time. In Helsinki, a protocol was signed in 1985 by the representatives of most European countries and Canada on reducing discharges of sulfur and trans-frontier streams of sulphurous compounds into the atmosphere. The signatories formed a club of "30 per cent", the figure corresponding to the substantial reduction envisaged by 1993, as compared to 1980. The protocol was drafted within the framework of the Convention on Long-range Transboundary Air Pollution adopted by the UN Economic Commission for Europe. However, the USA and Britain, parties to the Convention, refused to commit themselves to this undertaking despite the fact that it is the USA who is mostly to blame for acid rains in Canada, while two-thirds of the sulphur emitted by British thermal power-stations reach Northern Europe and Scandinavia. As Swedish scientists discovered back in the early 1960s, fish in Swedish lakes die as a result of precipitation originating in Britain.

5. South and North: Outlines of the Conflict

On the treshold of a new millenium, in addition to the threat of a nuclear Apocalypse and an ecological catastrophe, we are beginning to see

an increasingly exacerbating conflict between "the rich North" and "the poor South", that is, between the developed capitalist countries and the developing states. This confrontation leaves its imprint on the world situation and is fraught with unpredictable and ungovernable consequences which all concerned with the future of the planet would like to avoid. First of all, it is the problem of the developing countries which are actually placed in a desperate situation by the existing system of unequitable economic relations with the West.

However, is this not an overstatement? Indeed, many facts show that a number of developing countries have achieved impressive results in many areas of social development. Even a new term has been coined: "new industrialised countries". True, the largest non-aligned country, India, has long since acquired the status of a major state in terms of its industrial output. By carrying out "the green revolution", India has made certain progress in solving the food problem and eliminating hunger. It is successfully mastering science-intensive technologies including microelectronics and is engaged in implementing extensive computerisation programme. Or let us take another well-known example "the Brazilian miracle". Brazil, a giant of the developing world, successfully competes in the field of microelectronics and informatics with major capitalist

countries. And the glittering skyscrapers produced as if by a magic wand, are they not an especially vivid confirmation of the economic progress made by the oil producing countries of the Persian Gulf?

Of late, noticeable changes have undoubtedly occurred in many developing countries. Nevertheless, far from all developing nations achieved impressive economic results as did some young states. Moreover, there are some where the per capita incomes and production are declining and social contradictions are becoming more acute. For instance, beginning with 1980, in African countries the per capita incomes have been declining annually by 4.1 per cent on the average. We observe a bitter paradox: the more spasmotic the economic indices in a particular Third World country, the more tragic is the plight of millions of people when these indices decline as the result of the inevitable fluctuations in the world economy. And recently this has happened more often. Finally, for hundreds of millions of people who live in developing countries and often constitute the illiterate and homeless statistics, individual facts and figures are quite remote from their daily concerns.

From this viewpoint, let us more soberly appraise the "Brazilian miracle". Indeed, over the last two decades there have been substantial changes in the country: new industries have

sprung up and there have emerged new structures and mechanisms of state-monopoly economic management making Brazil similar in some respects to the industrially advanced capitalist countries. Over that period the proletariat has nearly tripled in numbers, from 8 to 23 million to comprise now about a half of the gainfully-employed population. There is a marked growth of urban dwellers who account now for about two-thirds of the Brazilians. However, the country still confronts unresolved social problems. It has to introduce a more fair distribution of incomes, eliminate hunger and poverty, reduce unemployment. Brazil has become more dependent on imperialism because most of the new industries are controlled by transnational corporations: 100 per cent of the automobile industry, 70 per cent of electronics, 59 per cent of machine-building, etc. In 1987, its foreign debt was about $100 billion. The number of insolvent small and medium-sized enterprises belonging to the national bourgeoisie is rising. 30 per cent of the industrial capacities are idle. The unemployment problem is getting worse with the employment level declining to that of 1969. Social unequality has sharply increased. The concentration of wealth is accompanied by the massive pauperisation of the people. Two-thirds of Brazilian families suffer from malnutrition. Every day a thousand children die, and in some areas the child mortality rate has

reached 40 per cent. Thus, upon closer scrutiny the "miracle" dissipates revealing severe social problems which remain unresolved despite impressive indicators of economic growth.

A French economist Maurice Allais estimated that in the countries of Asia and North America the living standards ratio in the 50's was 1:20 and in these countries and Western Europe — 1:10. And this gap is widening. US futurologists Herman Cahn and Anthony Wiener estimated that it will take Indonesia 600 years to attain the per capita incomes the USA had in 1965; Colombia — 350 years; and Nigeria — more than 300. Today, the ratio of the per capita final product in the newly-free countries and in advanced capitalist countries is approximately 1:12, and with the persisting present rate of unequal development it may reach 1:20 by the 21st century.

As was already noted, the present scientific and technological progress creates prerequisites for the elimination of the centuries-old backwardness of the developing countries. However, it is clear that such prerequisites are not enough. No doubt, low industrial and cultural development levels in most developing countries with the attending poverty and illiteracy, frustrates their efforts to overcome their economic and social backwardness. Of course, this is a serious brake on the social progress of the newly-free countries

impeding their industrialisation, the application of STR achievements and the intensive development of agriculture.

However, the root-causes impeding these countries to overcome their backwardness in a short period of time, lie in the colonial past, the continued exploitation of the manpower and natural resources of these states by foreign capital and the neo-colonialist policy pursued by imperialist states. It is these factors that underlie the crisis in relations between the imperialist and newly-free states, the acute crisis that erupted in the 70s. Its vivid manifestation was the massive movement of the developing countries protesting against imperialism and its neo-colonialist strategy, as well as their concerted actions in the UN. The developing countries urged the restructuring of the existing system of international relations with consideration for the legitimate interests of Asian, African and Latin American countries.

The shortage of means, machinery and specialists is the stumbling block to their efforts to utilise the opportunities offered by the present stage of scientific and technological progress to bridge the yawning gap between the socio-economic development of the industrialised and developing countries. Suffice it to recall that since the early 1980s the aggregate debt of the developing countries to the West has doubled reaching one tril-

lion dollars. Equally ruinous is the discrepancy in prices of raw materials and manufactured products. As a result, from 1981 to 1985, the interest paid by the developing countries on their debt had grown from 78 to 114 billion dollars and their receipts from raw materials exports (excluding oil) had dropped from 104 to 84 billion dollars.

Experts of the UN Centre on Transnational Corporations estimated that from 75 to 90 per cent of the world capitalist trade in major African exports is controlled by 15 transnational corporations. As a result, the producers receive only six per cent of the cost of the tobacco sold, 3 to 15 per cent for coffee, 12 per cent for bananas and 25 per cent for hides and skins. The first President of Tanzania, Julius K. Nyerere, said that within the framework of the existing world economic system, the developing countries had only the right to sell cheap and buy dear.

There are many other ways of pumping out money from the former colonies and impeding their independent development. These include the efforts of the USA, Japan and West European countries to preserve their monopoly on modern technology in their relations with the developing countries; the transfer of the most labour-intensive and ecologically "dirty" lines of production by some Western companies to Asia,

Africa and Latin America involving serious consequences for the developing countries. For their access to modern technology, the latter have to pay with environmental pollutions, a sharp social polarisation and, above all, with a greater economic dependence on the West.

Clearly, it is imperative to check the dangerous aggravation of contradictions between the developed capitalist states and the Third World. There is only one way out: a fair settlement of the debt problem, the establishment of economically-substantiated prices, the introduction of control over the activities of transnational corporations in the young states, the elimination of unfair protectionist barriers and other discriminatory measures. All this lies at the core of the idea of a New International Economic Order (NIEO) which implies a democratic transformation of the existing pattern of international economic relations whose formula has been elaborated by the developing countries. The basic documents for a NIEO are the UN Declaration and Programme of the Action for the Establishment of a New International Economic Order and the Charter of Economic Rights and Duties of States (1974).

The main idea of the Programme is an overhaul of the entire system of unfair relations prevailing in the world capitalist economy. Among other things, the Programme provides for the fol-

lowing: the establishment of full and unconditional sovereignty of states over their natural resources up to the nationalisation of foreign property; control over TNCs' activities and the elimination of discrimination in international trade; non-interference in internal affairs; inadmissibility of any forms of discrimination; recognition of the sovereign equality of states and a free choice of social development alternatives; effective overhaul of the international monetary system and the mechanism of external financing with due regard for the interests of the developing countries; improved terms and conditions in obtaining modern machinery and technologies.

A New International Economic Order is inseparable from the most extensive equitable and mutually-beneficial international cooperation between the developing countries themselves (South-South). The 8th Conference of the Heads of State and Government of Non-Aligned Countries held in 1986 made the problems of expanding the "South-South" ties the centre of its proceedings. Later, the participants of Group 77 issued a special statement at the UN stressing their determination to immediately and vigorously expand cooperation between the developing countries. A concrete step in this direction was the constituent conference of the African Petroleum Producers Association held in Lagos (Nigeria) in 1987. The Lagos resolution on the

establishment of this continental organisation was signed by the ministers of petroleum resources of Algeria, Angola, Benin, Cameroun, Congo, Gabon, Lybia and Nigeria. The establishment of the Association will allow African countries to influence to a certain degree the world market. Although they account for only eight per cent of the world oil output, these countries have some advantages over other producers: in Africa mainly light grades of oil are extracted which are believed to be the best in the world, thus, in great demand on that market. The working out of a united position within the Association will ensure maximum profits for its members.

In view of the great economic, social and political heterogeneity of the developing countries, their NIEO programme is inconsistent and rather vague in some respects. Its principles are not bold enough to restructure international economic relations within the existing world capitalist economy. However, if implemented, these principles would substantially curtail neocolonialist exploitation. Hence, the anti-imperialist and democratic thrust of the programme.

Socialist countries support the just struggle waged by the developing countries for the NIEO. At the 1987 Meeting of the Political Consultative Committee held in Berlin, the Warsaw

Treaty member-countries reaffirmed their determination to render assistance in overcoming underdevelopment, establishing a NIEO and restructuring economic relations on a just economic basis. They committed themselves to contribute to international efforts directed at ensuring economic stability and improving the political climate. Combined with the large-scale peaceful initiatives of the socialist countries, and above all the programme providing for the total elimination of nuclear weapons, as well as the concept of a comprehensive international security system adopted at the Berlin meeting, the document "On Overcoming Underdevelopment and Establishing a New Economic Order" gives new impetus to the struggle of progressive forces in the sphere of international economic relations.

Socialist countries believe that only a NIEO and ensured economic security of every state within the framework of a comprehensive international security system, could be instrumental in tackling urgent and difficult problems of the developing nations and overcoming their underdevelopment. They also stress that disarmament and development are tied up together and that at present these two concepts are more and more often referred to as closely related. Progress of mankind, the rational use of material resources and raising spiritual potential are unthinkable unless mankind eliminates the underdevelop-

ment of vast regions of the world, primarily former colonies. In turn, this programme requires tremendous financial backing which can be ensured only through the reduction of military expenditures, i. e. disarmament for development.

The use of financial resources thus saved for development could open up a totally different perspective for the newly-free countries. Reduction of military expenditures would put in order world commodity trade and improve the situation on the credit market. There would be available additional resources which could be channelled to deal with debt servicing. In any case, the present outflow of resources from the Third World could be replaced by an inflow. It would make it possible to avoid many relapses into power politics in international economic relations. UN experts note that in the long run disarmament will promote the economic and social development of all countries, particularly the developing, by bridging the economic gap between them and establishing a New International Economic Order based on justice, equality and cooperation in dealing with other global problems.[1]

[1] See: *Disarmament Yearbook*, U.N., New York, 1983, p. 493.

Thus, disarmament, a major step towards the establishment of a lasting world peace, would be a weighty contribution to world development.

6. Malthus and the Adding Machine

Over the last millenium the world population has increased 18-fold. While the first doubling of the population required 600 years, the second — 230, the third — about a century, the last took less than 38 years. Facing more acute global problems threatening its very survival, mankind has to give move consideration to the population problem. The growth rates and the pattern of the population distribution throughout the world seriously affect many other global problems such as environmental pollution, the depletion of mineral resources, food shortages, etc. Indeed, the rapid population growth not only renders these problems more acute but often makes their consequences more tragic.

Are there too many of us or barely enough? Can the Earth feed, clothe, and provide with all necessities so many people? UN experts forecast that the population of the planet now numbering five billion people will reach 6.119 billion by the year 2000. As expected, in this period the developing countries with their population growth rates four times higher than in the developed

states will account for almost 90 per cent of this increase.

As a result, with persisting differences in the standards of living, by the year 2000 about 80 per cent of the world population will live in the regions afflicted by food problems. Experts estimate that by the year 2100 the world population will have reached 10 billion and stabilise at that level.

What will be the food situation at this time? We have to take into account the fact that, as the UN estimates, today more than 200 million people suffer from malnutrition with more than a half of the population of Asia and a substantial part of the population of Africa and Latin America suffering from hunger. For instance, in Africa where in the last quarter of the century the population growth rates stood at 2.7-3 per cent a year and were the highest in the world, the population was 470 million in 1980 and is expected to reach about 850 million by 2000. Meanwhile, in 1984 food production dropped by 11 percent compared to the 1974-1976 period (South Africa excluded). For many nations the food deficit has become chronic and is plagueing even the regions which previously had enough agricultural products. At the same time estimates show that there should be enough food for 40-50 billion people if food production reaches the level attained by the industrially developed countries.

And what will happen to the natural resources in this case? Indeed, the growth of production will further exacerbate the ecological problem: environmental pollution, the depletion of energy and raw materials resources, soil errosion, etc. Perhaps, right are those Western researchers who blame the population growth or the so-called demographic explosion for the exacerbation of the ecological problem? Moreover, perhaps one can explain military conflicts in the Third World only by the struggle for resources, the "living space", food, in short, by the struggle for survival in conditions of the population growth?

Population problems are of concern for the entire mankind. With time some of them grow more acute, some become less pressing and disappear. In the approach to these problems many blatantly antiscientific and antihumane concepts are particularly strong and persisting. It applies first of all to Malthusianism and its modern modifications. Its founder, an English clergyman Thomas Robert Malthus (1766-1834), already in 1798 published his well-known *An Essay on the Principle of Population* where he claimed that he had discovered the source of all human misery, or "the natural law of absolute overpopulation".

According to this principle, if unchecked, population increases in a geometric progression every 25 years, while the means of subsistence

can increase only in arithmetical progression even under the most favourable conditions for human labour. Hence, Malthus alleged, the logical conclusion: the main or persistent reason for poverty does not in the least depend on the mode of government or an unequal distribution of property; the rich can not supply the poor with work and means of subsistence. Therefore, he went on, the poor have essentially no right to demand work and subsistence from the rich. A child born to a poor family is one too many.

Malthus and neo-Malthusianists suggest that it is wrong to resist this "eternal law of nature"; rather, one should help its most harmoneous realisation. Malthus attempted to explain the contradictions of social development not by social contradictions within the capitalist system but through the "eternal law of Nature". Thus, he ascribed the decisive role in reproduction to biological factors and explained the misfortunes of the people by their unrestricted reproduction.

As distinct from classical Malthusianism, the neo-Malthusians recognise the impact of social factors on the population. However, they place it on par with the impact exerted by biological factors. In their practical recommendations, they stress primarily the biological aspect of reproduction and push into the background all measures

intended to transform the economy, raise the living standards of the population, that is, the measures reflecting the social essence of this process. If Malthus recommended the curtailment of excessive reproduction by sexual restraint, his followers go further. They suggest that "moral" factors are not enough and that in order to artificially reduce the world population it is necessary to practise wide-scale sterilisation of "genetically inferior people", regulate birth rates by special permits, etc.

However, why is Malthus wrong? Indeed, birth and death, growth and ageing, sex differences are really biological processes. It seems on the surface, that reproduction and growth of the population and its density can be easily regarded as indicators determined by biological rather than social factors. However, here one overlooks the fact that in each society the dymanics of population growth acquire social character and depend on social conditions of people, the state and development of production, the cultural level, every-day life, national and religious traditions, etc. That is why there is no abstract, eternal or extra-historic law of population growth. Lenin noted: "The conditions for human reproduction are directly dependent on the structure of the different social organisms; that is why the law of population must be studied in relation to each organism separately, and not 'abstractly',

without regard to the historically different forms of social structure."[1]

Under capitalism, with the development of production serving the aim of ensuring profits, the rationalisation of labour and the introduction of the latest scientific and technological achievements in production, while tremendously increasing labour productivity, leads to unemployment. Marx showed that capitalism reproduces a surplus labour force deprived of the means of subsistence. This is the law of the population growth operating under capitalism. Together with the social inequality within the capitalist countries, the development of capitalism has engendered a widening gap between a few advanced capitalist countries and developing nations.

Under these circumstances, the cures suggested by Malthus and his followers sound cynical, to say the least. Indeed, facts prove that the available means of subsistence are sufficient to feed and clothe a population much larger than the existing one. Experts say that only 0.5 per cent of the present military allocations would be enough for the developing countries to purchase agricultural machinery which would ensure self-

[1] V. I. Lenin, "The Economic Content of Narodism and the Criticism of it in Mr. Struve's Book", *Collected Works*, Vol. 1, 1986, pp. 453-54.

sufficiency in foodstuffs for the least-developed states by 1990.

However, many countries encounter a number of impediments which can hardly be qualified as "natural". These difficulties frustrate tangible opportunities for mankind to get the means of subsistence it needs. These difficulties are nourished by the private, exploitary nature of the relations of production prevailing in these countries where development of the means of production is determined by their owner's profits received in the manufacture of goods rather than by the real human needs. The superprofits reaped by the arms manufacturers and death-merchants spur the military production thereby involving in the arms race even those countries where hunger claims thousands upon thousands of human lives. Thus, hunger and poverty afflicting the working people are due to social causes rather than being a consequence of the "eternal and natural" law professed by the Malthusians.Thus misery is not due to the natural lack of food.

No one doubts the existence of population-growth problems. It would be wrong to minimise them. Moreover, far from resolving the pressing demographic problems, the socio-economic and scientific and technological progress has rendered some of them more acute. Still, this fact by itself gives no grounds for pessimistic, the more so, apocalyptic conclusions. That is

why mankind cannot accept Malthusian prescriptions in dealing with the problem. Rather, humankind should create conditions which would ensure a worthy and happy life for the generations to come. Naturally, this does not imply that population growth should have no restraints. It is necessary to draw a clear line between birth-control campaigns launched in some specific circumstances and Malthusianism as an ideology whatever its modifications might be. "Freedom for medical propaganda and the protection of the elementary democratic rights of citizens, men and women, are one thing. The social theory of neo-malthusianism is quite another. Class-conscious workers will always conduct the most ruthless struggle against attempts to impose that reactionary and cowardly theory..."[1] The problem of population growth needs a sensible approach and consideration of the present-day realities.

In exposing Malthusianism and its ideological roots, one should comprehend the real problems which have been distorted by this trend. First of all, it concerns the model of agricultural production necessary to cover the requirements of the growing population. Another problem is birth control. These are intricate problems

[1] V. I. Lenin, "The Working Class and Neomalthusianism", *Collected Works*, Vol. 19, 1977, p. 237.

which do not submit to simplistic solutions.

As a result of rating the population problems among global more attention is now paid to the demographic policy, i. e. measures aimed at altering the pattern of population reproduction. These efforts are buttressed by immigration and emmigration controls, geographical distribution, and urbanisation control. Many state leaders, as well as broad public, are becoming increasingly aware of the fact that the most acute problems challenging many countries are those associated with the growth of population. In recent years, many countries opted for birth-control measures with varying degrees of success. In Pakistan whose population is expected to climb to 153 million by the year 2000, the Muslim clergy still resist any efforts in this field. At the same time, in China since the early 1970s, as a result of a strict "one family — one child" policy some progress has been made. In Zambia, with its present population growth rate standing at 3.4 per cent, schoolchildren soon will be taught demography. Today it seems to be advisable that information and knowledge in the field of family planning should be made accessible to city dwellers and peasants alike. People are to judge for themselves how the rate of population growth affects food-supply, housing, employment and education.

However, it should be stressed once more, that

despite demographic difficulties experienced by the developing countries which require a new approach in this field, one cannot ignore the fact that the socio-economic situation in this region results, first and foremost, from their exploitation by transnational corporations resorting to colonial and neo-colonial methods. It is the product of price disparities, indebtedness and military-political encroachments on the internal affairs of the newly-free states. This is the factor afflicting hunger, poverty and epidemics upon vast areas. Population growth is a secondary, rather than a primary factor, exacerbating the situation.

The developing countries are not the only ones which have to deal with the population problem. In the industrialised countries, the rates of population growth also substantially affect various spheres of life. As distinct to the discussions raging for some time around the population problems primarily associated with an accelerated population growth peculiar to the developing countries and labelled as the demographic explosion, recently we have had to deal with a "demographic winter", i.e. the plummeting birthrates in the developed and, above all, in West European countries.

For twenty years now demographers have been registering a sharp decline in the rate of population growth observed in the Old World.

A West German demographer R. Benkert, coordinator of the research recently conducted by the Council of Europe states that with the present-day rates unchanged the population in Western Europe will decline by 50 per cent by the year 2086. The study has shown the following: in West Germany the birth rate is 1.3, the lowest figure; in Holland — 1.49; Belgium — 1.61; Sweden — 1.73; Britain — 1.77; France — 1.82. Demographic shifts occurring in Western Europe affect its economy, the pattern of production, family problems, the labour market, education, the army, and social security.

Are these demographic shifts a kind of anomaly and will they replace the previous ideal of a large family with the ideal of small family? The tremendous development of productive forces accompanied by radical social transformations stimulated by the industrial revolution in the late 18th-early 19th centuries with their profound consequences extended in the 20th century, was instrumental in the transition from the outdated patriarchal household family to a "nucleus" family comprising parents and one-generation children, a family with totally different economic and social functions. In these changed circumstances, a woman becomes economically independent when maternity is pushed into the background due to the growing involvement of women in social, extra-household, production

and socio-cultural activities. The transformation of the outdated agricultural structures and the changing of material and cultural conditions of life within the family, inevitably obliterate the former need for children who were previously regarded as helpers in labour or a material support to parents in their old age. Lower birthrates are a result of low rates of child mortality and a push up of the marriage age because of the increased mobility of young people and as a result of other factors.

All these processes have been stimulated by the scientific and technological revolution. As a result, since 1964 the birth-rate indices began to fall in all West European countries and by 1975 they fell below the standard level of reproduction and was 2.1 children. This level continues to decline today. It seems that the descending of birth rates from the high level to the average is a natural consequence of economic and cultural factors.

At the same time, the lack of the economic need for children in some respects runs counter to social considerations engendering, thereby, a number of associated problems. Indeed, children are a potential labour pool. However, lower birth rates combined with the low mortality rates already achieved not only undermine the growth of labour resources but lead to their "ageing" or, as is said sometimes, brings about a "grey-

haired" revolution. Indeed, now we observe three trends: there are more elderly people; their average age is rising; this segment of society is expanding.

Meanwhile, modern production with its rapidly changing and more sophisticated technologies requires younger people. Moreover, in Western Europe we see a rapidly changing correlation of the able-bodied population and retired persons. In 1950, 156 out of 1000 were non-working people. According to the Statistical Office of the UN International Labour Organisation in 2025 the figure is expected to reach 455. All this involves higher expenditures for the maintenance of old people and entails a greater load on medical establishments.

In these conditions, the catastrophic decline in birth rates observed in Western Europe and linked with a number of factors causes, not without reason, serious concern. These factors include: the substantial deterioration of the social situation in this region over the last two decades; the arms race; the growth of military expenditures; inflation undermining real wages; economic crises of the mid-1970s and the early-1980s which affected employment; a further exacerbation of the unemployment problem caused by the "robotechnic revolution" above all affecting the youth. It seems that a certain negative impact on the birth rates was also made by the growing

fears of a nuclear war threatening future generations.

Today, most demographers recognise the difficulties involved in overcoming the negative demographic trends. Measures to stimulate the growth of birth rates do not always bring positive results. France, where in the 19th century birth rates had been the lowest in Europe, since the 1930s has pursued a vigorous policy encouraging birth-rates growth. All parents receive allowances for children, there is a network of nursery schools, and a sliding scale has been established providing for lower taxes with the birth of each child. Still, despite all these efforts the birth rate in France has declined from 2.7 in 1960 to its present figure of 1.8.

Many people believe that economic assistance to young parents is not enough and has to include a wide range of socio-economic, political, cultural and socio-psychological measures both on the regional and international levels. Many demographers in Europe are of the opinion that the most effective method of combating the demographic crisis and the attending problems in Western Europe would be shifting the huge military expenditures to peaceful purposes such as the support of the youth, economic assistance to the family and the introduction of programmes of material security for the old people.

Socialist countries may serve as an example in

carrying out extensive measures aimed at stimulating birth rates and improving the well-being of large families. For instance, the German Democratic Republic has long introduced a successful system of stimuli to mothers and measures strengthening the family. All mothers are granted a paid maternity leave with the leave extended to twelve months after the birth of the first child. There exist various benefits to large families. An interest-free credit is granted to young couples with part of it being canceled with the birth of a child. Parents receive a monthly allowance on each child, and its sum is increased as the number of children increases.

These and many similar measures exist in other socialist countries as well.

Chapter seven

MANKIND'S FUTURE AND THE SCIENTIFIC AND TECHNOLOGICAL REVOLUTION

At the threshold of the third millennium, a discernable image of the future human society appears before the very eyes of our contemporaries. That future inspires both fear and hope. Will the human race prove capable of solving its problems, eliminating the spectre of thermonuclear apocalypse, saving perishing Nature, feeding all the hungry and providing homes for the homeless? Its very existence depends on the effective resolution of these and many other problems. The socialist society has set itself the task of ensuring that the great achievements of the present-day STR are wholly placed at the service of man, promoting the ideals of peace and social justice, the

prosperity of all peoples and helping to develop man's abilities and a harmonious relationship between society and Nature.

1. The Acceleration Strategy Is a Breakthrough into the Future

In the mid-80s the socialist community countries adopted measures aimed at a fuller use of their scientific and technological potentialities to advance their national economies. Changed economic conditions in these countries themselves and in the world at large, the imperative need to switch the economy to the path of intensive development and use more vigorously the achievements of the STR — all this demanded that a new strategy be applied, the strategy of accelerating the socio-economic development of socialist countries on the basis of an effective use of the STR achievements. Speeding up scientific and technological progress and radically transforming the productive forces of society constitute the most important means of implementing that strategy which presupposes a radical transformation from extensive to intensive development of the national economy.

A penetrating analysis of the economic conditions in socialist countries revealed that funda-

mentally new technological systems and technical equipment of the latest generations providing for the highest possible efficiency were demanded. As a matter of fact, socialist countries need to modernise all sectors of the national economy through the latest achievements of science and technology, for no further progress could be ensured on the obsolete material and technical basis.

And, indeed, as was revealed, if the planned increment in the Soviet national income was to be reached on the former, largely extensive basis, it would be necessary to expand the extraction of fuels and raw materials every five years by 10-15 per cent, increase capital investments by 30-40 per cent, and employ on additional 8-10 million workers. But the Soviet Union does not possess such potentialities. At the same time, in most industries scientific and technological progress proceeds mainly along evolutionary lines, largely by improving the existing technologies and modernising only part of the machines and equipment. However, extensive development of the economy based as it is on evolutionary technological progress, has exhausted its possibilities.

Thus the sole way out consists in a deep-going reconstruction of the entire national economy based on the latest scientific and technological achievements, and in a restructuring of the economic mechanism and management system.

With this idea in mind, specific guidelines were formulated for science, technology, and production to accelerate this progress and switch the economy on the path of intensive development. In the forthcoming 15 years, this would renew production assets, double industrial output and increase labour productivity by 130-150 per cent. What are the tasks facing the system of scientific-technological production?

Science, in socialist society, must occupy world's leading positions in the priority areas of scientific and technological progress, providing effective and timely solutions of current and perspective production and socio-economic problems. As they arise and are materialised in production, scientific ideas pass through the stage of fundamental and applied research and development. What is more, scientific and technological progress cannot be accelerated unless priority is given to fundamental research which generates fresh ideas and provides for pilot breakthroughs into new areas. And if fundamental sciences develop at rates faster than those of applied sciences and research and development, imparting to them a certain "theoretical scope" for effective and rapid development, the latter, in turn, must develop at rates faster than those of production. Only in this way can a radical technological renovation of production in the shortest possible time be assured. In this connection, the task has

been set constantly to improve the organisational-economic patterns of integrating science and production, effectively guiding scientific and technological progress, widening the range of promising applied research and development and raising its efficacy. For that reason, great significance is attached to strengthening the links between the institutions of the USSR Academy of Sciences and its republican branches, institutions of higher learning and industrial research centres.

In the USSR, a form of combining science and production has been established in the shape of science-production and production amalgamations. Industrial enterprises, designing offices and research centres are merged so that discoveries and inventions be introduced promptly into the production cycle, and specialising or cooperating along various lines of production be carried out. The effective use of this pattern of integrating science and production is revealed by the following fact. Whereas in 1970 Soviet industry had 608 such amalgamations which accounted for 6.7 per cent of the industrial output of the USSR, in 1985 their number reached 4,400 accounting for over half the country's industrial output.

The need for such cooperation of science and production is now felt not only in individual socialist countries, but also in the whole community, where joint science-production amalgama-

tions and joint production ventures have been launched and function efficiently.

There are also other patterns of merging science and production. Thus, many factories have their own research and development centres servicing their specific needs. And, vice versa, the industrial base of many research and development centres can be compared to that of large industrial enterprises.

It should be noted, however, that the available scientific and technological potential is not always used to the full. Some science-production amalgamations and many institutions of the USSR Academy of Sciences, as well as higher educational establishments and industrial research units, still do not work as they should in solving major problems in the development of the national economy. Introduction of scientific discoveries and technical innovations is still too slow. The lag in strengthening the ties between science and production as well as die-hard formalism in this matter is actually causing great economic, social and moral harm to society, slowing down both socio-economic, scientific and technological progress. For that reason, together with the already existing patterns of combining science and technology, search is under way for new forms that would embrace practically all stages of the innovatory process — from the birth of scientific ideas to their application in industry.

One such new and effective pattern of combining science and production is the fundamentally new type of organisations being set up in the USSR — the inter-sectoral scientific and technological complexes. They are established on the base of large research institutions possessing well developed experimental, research, development and production facilities capable of solving promptly and effectively the tasks of implementing scientific ideas and technical innovations. A new step in this direction is the formation within their framework of problem-orientated units — engineering centres. Basing themselves on the results of fundamental research, these centres are designed to introduce new progressive technologies, materials, machines and equipment, management systems and help production amalgamations and factories effectively apply them on a large scale. The inter-sectoral scientific and technological complexes act today as an organisational pattern making it possible for optimally transforming science into a direct productive force. The STR transforms the knowledge embodied in the new plant and technologies, the skill and know-how of workers into an inexhaustible source for intensifying economic activities.

A radical restructuring of the national economy of socialist countries on a new technological basis must not be confined to partial improvements in

production, no matter how large their scale of introduction may be. It implies a fundamentally new approach to the economic activity of society as a whole. In the view of the Soviet economist, Leonid Abalkin, acceleration primarily calls for profound changes in the economy as a decisive sphere of human activity. Their essence lies in the new quality of growth: a comprehensive intensification of production through scientific and technological progress, the restructuring of the economy, efficient management, organisation and stimulation of labour. The programmes for intensifying the national economy mapped out in socialist countries presuppose sharp reduction in the ratios of assets to output, materials to output and energy to output and a radical rise in production efficiency. An increased science-intensity of production materialised in new generations of technical equipment, new technologies and higher skills, is the most effective and promising way of accomplishing that task.

Accelerating scientific and technological progress is today a means of practical solution of topical problems of the social and economic development of society. The socialist countries' efforts in this respect receive an additional impulse because they can jointly use the scientific and technological potential of the socialist community as a whole.

2. Force of Interaction

The sharp turn by CMEA member countries toward accelerating scientific and technological progress was objectively determined by the entire trend of their social development and the urgent needs at the present stage. A coordinated strategy of cooperation in this sphere is expressed in the Comprehensive Programme of Scientific and Technological Progress of CMEA member countries up to the Year 2000 adopted in 1985.

The chief goal of the Programme is to pass over to a concerted scientific and technological policy in the priority areas of the national economic development of countries making up the socialist community. From now on, the main effort to intensify the socialist economic integration of CMEA member countries will be to master the latest achievements of science and technology and pursue a policy of large-scale cooperation in all industries, especially in the production of modern machinery and equipment.

What has projected integrational measures in science and technology to the forefront? The reasons are not fortuitous, for they are dictated by the actual requirements of CMEA member countries at the present stage of development, the need to pass over to the intensive methods of running their economy, which is only possible if fun-

damentally new plant and technologies are developed and introduced.

Beginning with the early 70's, new, often unexpected types of plant and technologies made their appearance and rapid headway, rendering it possible considerably to reduce the consumption of resources and raise the quality of production. Their development and introduction into production entail enormous costs. And if we consider that development of new technologies involves a greater degree of uncertainty and risk, it becomes clear that uniting the countries' efforts to realise large research and development projects is an objective necessity. And just as much needed is concentration of the best researchers and experts of various countries on major areas of scientific and technological progress.

Finally, in the contemporary international situation the advanced areas of science and technology became spheres of acute competition. The international prestige of the socialist community and its ability to counteract imperialism and safeguard world peace depend now on how rapidly CMEA member countries make use of the latest scientific and technological achievements. Advancement to new technologies and their effective mastery is today not only a vital need, it is a prerequisite for the existence of socialist society. Obviously, the Programme adopt-

ed at this juncture is both of great economic and political importance. Another major reason for the launching of the Programme was the effort to reach the world's highest standards of production, since top quality of goods, their competitiveness on the world market can be easier achieved by joint efforts.

The CMEA member countries possess everything necessary to solve new and more complex problems. Their economy is run in a planned manner drawing upon a well-developed scientific and technical potential and a mature production foundation. This has enabled them to attain serious results in the sphere of science and technology.

Socialist countries not only import, but also export most diverse, modern goods and ideas, ranging from constructive technological solutions to finished goods, including high-performance machines and equipment. Thus, the Japanese iron and steel industry uses the technologies of the continuous pouring of steel, evaporation-based cooling of blast furnaces, dry quenching, as well as technologies and plant for electric slag-resmelting, automatic welding on licences bought in the USSR. Soviet licences are also used in the USA: surgical sewing instruments, technology of subterraneous gasification of coals, pouring of aluminium and copper in the electrostatic field, a method of treating instruments with

nitride of titanium, a method of magnet-impulse forging, the evaporation-based cooling of blast furnaces, arc welding of rails, and many other methods and technologies.

Successes of Soviet science in the exploration of outer space have long been well known. They have been recently reaffirmed by the launching of the orbital research station "Mir" and the flights of the interplanetary stations "Vega-1" and "Vega-2". By means of apparatuses jointly developed by scientists of the USSR, Austria, Bulgaria, Hungary, the GDR, Poland, France, the FRG and Czechoslovakia, high-resolution pictures of Halley's comet were made for the first time, and measurements conducted of its various physical and chemical properties.

Socialist countries' achievements in developing the power industry, producing digital lathes computers and electronic equipment, as well as in various branches of medical sciences are also well known. Successes of the Polish school of mathematicians and physicists, GDR's achievements in electronics and optics, works of Hungarian scholars in the physics of the solid body and pharmacology, Czechoslovakia's successes in cybernetics and metal science, Romanian researchers' achievements in the chemistry of high molecular compounds, and Bulgarian attainments in the field of metal science, won them international recognition.

This is not accidental, for in the countries of the socialist community more than 5,000,000 people are employed in the spheres of science. CMEA countries possess at present 20 per cent of the world's patents for new technologies and modern machinery. Moreover, enormous experience has been amassed in multilateral scientific and technological cooperation, in which some 3,000 scientific and research organisations take part. Such a scale of cooperation enables socialist countries relying on their own forces to solve the overwhelming majority of their national economic problems.

Five priority areas have been singled out in the Comprehensive Programme with due consideration for the basic characteristics of the present stage of development of the STR: comprehensive electronisation and automation of the national economy, an accelerated development of the nuclear power industry, creation and introduction of new materials, development of technologies for their production and processing, and development of biotechnology. The traditional patterns of cooperation of CMEA member countries are being reshaped in the process. Prior to the adoption of the Programme, joint scientific and technological projects were run on the basis of coordination. However, when it became necessary to advance to the world's highest standards of production and attain technological independ-

ence, the need arose to map out long-range plans of cooperation embracing all stages of research and development — from fundamental research to the output of finished goods. Orientation on finished goods showed that mere coordination of research projects was no longer enough and new patterns of a closer cooperation were needed.This gave rise to the setting up of joint scientific and technological research teams, science and production amalgamations, joint ventures, i.e., to an intensification of integration.

Some new forms of work to implement the Comprehensive Programme have also come to the fore. Very popular today are international *ad hoc* scientific and technological teams of researchers oriented on the solution of specific problems. Thus, a Soviet-Bulgarian *ad hoc* group of scientists has been functioning since 1986 to provide architectural solutions to highly efficient computer systems. All in all, agreement has been reached to set up more than 100 international *ad hoc* groups of scientists and researchers.

Concentrating the efforts of the best scientists and experts of CMEA countries and their funds on these five areas will make it possible to fully modernise in a short time their entire national economy, placing it on a fundamentally new basis and, what is most important, making it

more flexible and more sensitive to the changing needs of society. It is planned to create more than 1,500 types of new machines and equipment, 500 technologies, over 400 new materials and accomplish a number of researchers.

Implementation of the Programme would not only restructure the production of goods and services, it would also improve the working conditions of people, making their everyday life easier, raising their educational and cultural standards and adding a new, bright and meaningful dimension to their lives. This is the main aim of the Programme to be achieved by CMEA member countries, for they intend to use and are actually using all the achievements of the STR to satisfy man's needs, his aspirations, strivings, and dreams. Besides, Programme symbolises and exemplifies international cooperation in science and technology conducted precisely in behalf of man.

Western propaganda spreads widely the idea that the Comprehensive Programme is the answer of socialist countries to the West European Programme Eureka. But, as we know, the decision to work out the Programme and the choice of its priorities were made in June, 1984, i.e., at a time when the Eureka Programme was unknown since it was just non-existent. Coincidence of many priorities of the two programmes can be very easily explained: scientific and technological

progress is global in its nature and its logic holds true for the world at large. But the similarity of the two programmes notwithstanding, the Comprehensive Programme is much broader in scale and more multiform in terms of problems to be solved. Moreover, considering vast scope and complexity of the changes needed to introduce new generations of integral technological systems, the main imperialist centres — the USA, Western Europe, and Japan — have had to borrow from socialism patterns they have not previously been accustomed to use. What is meant is primarily the working out of state-sponsored and inter-state programmes of scientific and technological development. The case in point is the Eureka Programme, which represents an attempt to combine the West European countries' potentials and concentrate the efforts of their scientists to speed up scientific and technological progress. Japan has also worked out the Technopolicy Programme which provides for prompt application of new and effective technologies.

That the Comprehensive Programme is a peace-oriented programme is borne out by its entire content. It stands to reason, that in the present situation CMEA countries have to develop military means to secure a safety defence of the socialist world system. But it is not the guiding principle in deciding on accelerating scientific

and technological progress. It is to unite the best scientists and researchers in socialist countries to place the miracles of modern science at the service of peace that is the goal of CMEA member countries. This makes it clear that its fulfilment is only possible in conditions of peace.

It is clear that by fulfilling the Programme, CMEA countries would strengthen their scientific and technological potential, and enhance their economic security and technological and economic independence. But this does not mean that they want to isolate themselves from the world community. On the contrary, considering scientific and technological progress to be a global process, CMEA countries seek that scientific and technological cooperation be carried out also on a global scale, and, as the Programme stresses, are prepared to take part in the elaboration and implementation of a single global programme in that sphere. Socialist countries have always favoured wide international cooperation in science and technology and a mutually advantageous division of labour in that sphere.

Recent experience, however, compels them to take steps to strengthen their technological independence, especially since the West is not averse to use from time to time scientific and technological exchanges as a weapon of blackmail and discrimination. As back as 1949, a Coordi-

nating Committee of East-West Trade Policy (COCOM) was set up to control strategic exports to socialist countries. US administrations have been using this Committee to undermine international trade in a long-term technological warfare against the socialist countries.

Participating in COCOM are NATO countries (except Iceland) and Japan. Although COCOM's decisions are not obligatory upon all member states and are implemented in accordance with their political commitments, the US is practically always in a position to induce its allies to follow COCOM's recommendations and severely punish the "dissidents". A case in point is the Japanese firm Toshiba, which sold milling machines to the USSR. The US tries to radically modernise the COCOM by strengthening its organisational functions and turning it into a standing commercial and political body with an international status. To this end, it is planned to increase its budget and control functions, enlarge the lists of goods fully prohibited for export to socialist countries, including "crucial" civil technologies. Of late, many types of computer, electronic and robot equipment and other science-intensive technologies have been added to these lists.

It is absolutely clear that joint efforts of states in the use of scientific and technological achievements for peaceful purposes in behalf of all na-

tions would greatly ease international tensions, marking a step towards a NIEO. The Comprehensive Programme points out that in realising it CMEA member countries proceed from the tasks of preserving peace and ensuring the security of peoples. It thereby states in no uncertain terms that the socialist community countries seek to place the STR achievements at the service of the entire humanity, not for the destruction of civilisation.

It should be also noted that the implementation of the Programme confronts certain difficulties, which primarily are the result of "growing pains". For the Programme is unprecedented in world experience in terms of its scope, time limits and expected results. Naturally, the tasks set require an adequate mechanism to realise the Programme, one that would, in turn, fit in with well developed mechanisms of running national economies and the economy of the community as a whole. Meanwhile, national mechanisms of a new type are only in their initial stage in CMEA countries. Old, traditional methods of management still persist and not everywhere have effective patterns been found for combining science and production. The cost-accounting methods are applied all too slowly, and the old mechanism oriented mostly on inter-government cooperation continues to operate, hindering the interaction between the basic participants re-

sponsible for economic contacts — factories and production amalgamations. Experts believe that certain targets of the Programme have not been properly studied from the viewpoint of their technical and economic feasibility. Serious measures are to be taken to ensure that all joint efforts render practical results.

Generally speaking, there is a lot of work to do to improve the structure and mechanisms of the Comprehensive Programme, all conditions to achieve this being on hand. The Programme of socialist countries calls upon all other countries to enter the 21st century fully armed intellectually and technologically, free from armaments, prepared to cooperate in behalf of peace, scientific and technological progress and the prosperity of humanity.

Chapter eight THE STR AND THE FUTURE OF HUMANITY

The central problem, around which focus all other problems of the scientific and technological revolution, is that of humanity. It is, therefore, the social and human dimension of the STR that attracts most attention of both scientists and the public at large. For scientific and technological progress cannot be considered apart from man and the humankind. Man is a complex social and biological being, representing a unity of natural and socially acquired qualities. And it is this multiform combination of qualities that in the long run constitutes the essence of the notion "man". Stressing that social qualities are the main, de-

terminant ones, Karl Marx defined the human essence as "the ensemble of the social relations".

The problem of the impact of the STR on man has become especially topical today. It is essentially the problem of whether scientific and technological progress is at the same time human progress. What will be the role and place of man in the future, perfectly automated production? What are the prospects opening up before the individual in the "computerised society" of the future? Is man threatened with becoming a sort of an "appendage" of the constantly improving technology, or will he assert himself, according to Marxists, as a versatile and perfectly developed individual as the STR develops? What are the demands that scientific and technological progress make upon man, his abilities, educational standard and skill?

1. Labour in the Forthcoming Millennium

At the threshold of the technological era of the 21st century, it is becoming increasingly clear that the present stage of the STR is bringing about radical changes in production technologies and in the working fuctions applied, raising substantially labour productivity, changing and making more complex relations between man and technology, and altering appreciably the

structure of man's professional activity. As the general trend of the STR, automation gradually removes man from the direct technological process. But, at the same time, man continues to work productively side by side with automatic equipment, coming forward as its creator, adjuster and superviser. As a result, the volume of physical labour is considerably reduced and work becomes primarily brain work.

This entails changes in labour, production and social spheres. The latest achievements of the STR have radically altered the degree of intellectual saturation of labour, the ratio between physical and mental efforts, diversifying man's operations in the labour process. The nature and content of work are changing in favour of searching, creative and purpose-oriented functions, leading to the elimination of distinctions between mental and physical labour increasing demand for higher skills and a greater number of highly qualified personnel servicing automatic machinery and technology. In addition to empiric knowledge and everyday experience, production activity is today unthinkable without systematised theoretical knowledge. It becomes increasingly clear that it is predominantly human labour in the shape of applying man's intellectual, moral and cultural abilities, and not so much his physical efforts, that is becoming the most important determinant of

production and all other creative activities of society.

At the same time, contemporary fundamental changes in production and introduction of machinery and technologies of the latest generations, give rise to complex problems in labour, production and social spheres, which are being solved differently in the different socio-economic systems. In these systems, the specific social forms in which general "technological" trends and traits of changing labour activity express themselves as a natural result of the unfolding STR and its essential requirements are fundamentally different. Under capitalism, the removal of workers from production takes the shape of coercive alienation of them from work, for capitalist "rationalisation" disregards the social aspects of the problem. Under socialism, labour resources are, as a rule, released for work in other economic sectors and industries, i. e., for work which is more creative and more efficient from the social point of view.

Introduction of new machinery and technologies under capitalism leaves its imprint on the nature of labour, making it more intensive and forcing workers to abide by the inexorable rhythm of mechanisms. Here, computers are employed not only to control various processes, but every movement of the workers themselves. Thus, a new kind of "Taylorism", or as we

termed it earlier "Computer Taylorism", is born.

"Computer Taylorism" gives rise to dissatisfaction with work, feelings of despondency, depression, and irritability, which often cause heart diseases and mental disturbances. Some Western specialists believe that the computer onslaught on human activity results in a massive "computer syndrome". It is a state of constantly feeling fear that computers will cause unemployment, and apprehensions that fatal errors can be made through wrong application of computers, especially in the event they are used by the government for the control of society, as well as fears of the computers' dehumanising impact on the life of people. It is obvious, that the cause of possible consequences is primarily the way in which technology is used by monopoly capitalism, not its introduction.

It would be, of course, oversimplifying to assert that introduction of new machinery and technologies in socialist society is a smooth process with no negative consequences. Thus, there are quite a few cases when computerisation and development of informatics come up against serious barriers due to a number of factors, including conservative attitudes, red tape, incompetence and fear that "thinking machines" will outdo living workers. Resistance here is often both overt and covert. Another source of difficulties is that

some industries, farming and management systems are not properly prepared to apply new information and computer equipment. For the effect of computerisation process is determined not only by the number of the computers introduced, but also by the radical changes in the entire technology and the structure of production and management they have wrought.

Furthermore, rapid in some cases radical changes in the technical and technological basis often result in making the existing production experience and knowledge outdated and in bringing about new qualification requirements as regards all professional occupations. The need arises systematically to refresh and retrain practically all categories of workers. Otherwise, the effect of computerisation would be somewhat diminished. Moreover, undesirable social consequences may ensue, such as shortages of skilled labour in some industries and surpluses in others.

The needs of social and economic development of the USSR require that all aspects of life of Soviet society be restructured. Perestroika or restructuring must not only do away with stagnation and conservatism typical of the preceding period. It also means rectifying the mistakes made and must overcome the historically formed stereotyped and obsolete features of social organisation and work methods. Besides, its aim is to impart

to socialism most modern forms commensurate with the conditions and requirements of the scientific and technological revolution and the intellectual progress of Soviet society. Hence, problems related to the impact of STR do arise in socialist society as well, and they must be solved in good time. But approaches to their solution here are quite different. The planned nature of socialist economy and the comprehensive, systems character of scientific and technological policy provide for a humanistic orientation of the development of production and solution of the resulting practical problems.

The conception of accelerated socio-economic development of the socialist community countries is an example of the creative approach to the resolution of tasks related to the development of science and technology with due regard for advantages of socialism. National economic plans serve as a system for pursuing a single scientific and technological policy, making it possible to plan the entire cycle of research and development and take advantage of the international division of labour, primarily within the CMEA framework.

Planning also incorporates social aspects of development: a long-range approach to the availability of labour resources, training and retraining of personnel, pension policy. The efficacy of development is assessed with due regard

for the close interconnection and interdependence of technical, economic and social aspects.

Can it be said that man's work in conditions of the STR has become easier? There is no single answer to that question, even if we draw from the nature of socio-political system. By and large, labour performed by workers today in its content draws nearer to that of engineers and technicians. As certain categories of trades disappear, the share of manual labour decreases and new trades make their appearance, such as tool and machine operators, adjusters, and computer programmers, whose work is predominantly mental.But that process should not be idealised, for there are quite a few jobs which have undergone substantial changes in the course of the STR. And it is hardly possible definitely to state that in the future there will be no physical work. For physical activity is not confined to the production of material values, which, in the long run, machines will take over. Thus, there is work performed by artists and sculptors, requiring not only mental, but also physical effort, bringing joy and aesthetic fulfilment, and which machines will never be able to fully replace. Generally speaking, work is becoming easier in the physical sense, but in no way can it be compared to a child's game, as it is sometimes said. Actually what is taking place is that the constant process

of scientific and technological production and labour are becoming ever more complex. Tuning up and adjusting machines and equipment, exploitation of systems which are considered to be complex in terms of their design and construction, require special knowledge and immense mental and emotional strain. What we have here is intensification of mental activity. In other words, work in no way becomes a pastime. Moreover, specialists state that work has become extremely complex, more tense and placing great mental strain on people. For one, the operator of an automated production line must perceive, process and retain a great amount of information, making instant decisions and giving orders to the machine. This results in considerable mental strain. Strain also builds up as regards various analysers, particularly in respect to sight and hearing. A high degree of alertness has to be maintained throughout working hours to take prompt action. This is only possible with the utmost precision and speed of the operator's motor reactions and sight perceptions, his most concentrated attention, promptly switching it to and keeping it always on a stable level. All this not only exerts a profound psychological influence, but, as medical observations show, contributes to the quick onset of fatigue and lowers the capacity for work.

Experience in controlling modern technology

bears out that mistakes in analysing the reasons for faulty performance of automated systems often lead to the inadequate actions of operators, resulting in accidents, stoppages and sometimes even catastrophies. Indeed, mistaken movements of a lathe operator resulting in rejects, cannot be compared to errors committed by operators of automated production lines, nuclear power stations or airport dispatchers. When an accident occurred in 1979 at the Three Mile Island nuclear power station in the US, some 1,300 signals flashed and sounded at the central control board in the next 30 minutes. The state of stress prevented operators from detecting in good time the faulty block, and their actions only worsened the aftermaths of the accident.

As we know, working conditions are determined by the specific social system, the level of development of technology, the degree of technical progress and the rational organisation of production meeting all sanitary standards. Much is being done in socialist countries to improve organisation and conditions of labour. Comprehensive plans to improve protection and introduce sanitary and health-building measures have become part and parcel of plans of economic and social development at all levels of planning.

A course is being steadily steered to lessen the share of manual operations, substantially reduce

and subsequently do away altogether with monotonous, physically arduous jobs of unskilled labour, providing for healthy sanitary-hygienic and safety working conditions which would help control occupational injuries, accidents and diseases.

The organisation of labour of millions in a principally new way at national levels is one of socialism's most important achievements. The Comprehensive Programme of Scientific and Technological Progress of CMEA Member Countries states that socialist countries work to solve the task of substantially improving working conditions and conditions of everyday life. In other words, technological restructuring is given a clearly social orientation. Thus, the task is set of developing such technical systems as would readily adjust themselves and promtly respond to man's commands, freeing people working with them from many unessential operations. Researchers are seeking to teach computers to learn the characteristic peculiarities of their operators, helping, not manipulating them. In other words, everything possible is being done to prevent people from developing a "computer syndrome". At the same time of interest is another aspect of the problem: it is necessary not only to adjust technology to man, but also to shape actively man's abilities in line with the requirements of scientific and technological progress. For man himself

proves today to be the "weakest" link in technological progress.

You cannot pursue a long-term social policy unless man's emotions, feelings, aspirations, and orientation on particular value, his labour and creative activities are considered. One may depict vast vistas and set seemingly attainable social goals, but if the resources of the individual are neglected, nothing will come of it.

In socialist countries, the human factor can best be invigorated by closely combining a weighted economic strategy, strong social policy and purposeful ideological and educational work. More firm discipline, proper provision of material incentives, a fight against abuses and other negative phenomena, removing barriers preventing people from showing what they can do in work and in creative endeavour — all this greatly helps to reveal the potentialities of the individual. Under conditions of the STR, particularly important are such qualities of a worker as his competence, intelligent methods of work and thinking, the will to uphold everything that is new and progressive, and irreconcilability to conservative and stagnant practices, his talent, enterprise and practical seize.

Under socialism the labourer is stimulated not only materially but also morally. The latter incentives are of great importance and include social esteem, respect on the part of one's fellow work-

ers, opportunities to raise professional skill, access to the latest achievements of scientific and technological progress. Proper use of these incentives would, undoubtedly, contribute to the further development of the human aspect.

Man of the future society should not only be a highly qualified worker possessing all the necessary knowledge, but also a subject who understands and appreciates the social aims, significance and the end result of his work. That is why today, when all spheres of socialist society are being restructured, the training of highly qualified workers whose scientific and technological standards are constantly growing, assumes such great significance. All this makes it necessary to combine closely educational, cultural, ideological and political means essential to reveal man's potentialities, implanting in people's minds a radically changed attitude to new machinery and technologies.

2. What Man of the 21st Century Should Know

New technology and the ample possibilities it offers give rise to demands for a wide variety of human talents and abilities. In conditions of automated production, man, as the subject of labour, should possess wide and profound knowl-

edge, solid and versatile skills, high cultural and educational standards, and treat responsibly his work.

A wide range of steps being taken in socialist countries to improve educational and professional standards, including reform and restructure of all levels of public education, is both the product of the present stage of the STR, and its indispensable condition.

Under socialism, the attitude to the intellectual wealth of society, and to the development of the educational system, differs radically from that of capitalism. In capitalist society education and the attainment of professional skill are the privilege of a few people. For many it is generally inaccessible as a result of the rapidly raising cost of colleges and universities. As for teaching US students on credit, that practice practically binds graduates for many years to come, until the indebtedness is repaid. As a whole, the selection and competent training of students and graduates practised by many monopoly corporations is accompanied by the general anarchy in society at large. As a result, hundreds of thousands of graduates cannot find use for their knowledge abilities, while college graduates in other fields are in short supply.

In socialist society, the educational system, professional orientation and vocational training is the direct concern of the state. Society pays all

education expenditures, including for higher education, which is within the reach of every citizen. Effective use of labour resources and the intellectual potential forms an integral part of the long-term plans of economic and social development. Implementation of the ambitious tasks of accelerating socio-economic development that face socialist countries today will largely depend on what kind of younger generations educational institutions will train in the future. In particular, a major social problem of improving the educational system in socialist countries is to heed, and respond correctly to, the impact of the STR on training, especially the demands the present stage of society's development and accelerated scientifical and technological progress make on the content, structure, aims and methods of training. Today, the STR places greater demands on workers and specialists, as a result of the introduction of new technology, the changed relationship between manual and mental labour in favour of the latter, and, as a consequence, general intellectualisation of work. The need arises for a fundamentally new type of worker with a more advanced general and specialised education.

Making all spheres of man's activity unprecedentedly dynamic, the STR has brought about changes in new generations of machines which are rapidly outpacing changes of the generations

of workers. In advanced industries, several generations of machines and equipment change within the span of the active service of one worker. If not long ago, an arithmometer and a side-rule were considered the "acme of human thought" compared to the abacus, a modern microcalculator has become today a customary tool used on a mass scale. With the beginning of the STR (some four decades ago), three generations of computers have succeeded each other, and a fourth generation is emerging and researchers are successfully developing a fifth one. One generation of telecommunication satellites is replaced by another every few years, while the entire space technology undergoes a fundamental change. Supersonic liners and aerobuses have made their appearance in aviation. Even in such traditionally conservative industries as textiles and footwear, new generations of plants are regularly introduced. Appearing three or four decades ago, television is also undergoing fundamental changes approaching, as experts believe, a "revolution in television". They also believe that changes of generations of machinery will not only proceed at increasingly faster rates, but will spread to ever new areas.

The enormous build-up of information, the information "explosion", and the outdating of existing knowledge, places additional demands on workers' skills, and, consequently, on the sys-

tem of training. If formerly knowledge acquired by a worker through his general, specialised or vocational training sufficed him practically till the end of his labour career, today, in conditions of the STR, when the volume of knowledge is doubled in very short periods of time (in 5-7 years in the especially rapidly developing areas of science, and in 15 years in some areas of applied research), the situation is now changing radically. Moreover, many trades and occupations may altogether lose their raison d'être and become redundant in the life-time of one generation. What is the way out? It lies in creating flexible and dynamic educational systems, enabling graduates to preserve and constantly refresh their occupational competence throughout their labour activity. Such systems should provide both the widest possible volume of theoretical knowledge and the highest possible professional skill in a particular trade. The aim of such a system of education should not merely be to give graduates higher general education, but primarily endow them with the ability and will to acquire ever fresh knowledge, to skilfully use information, treat their work creatively and be prepared psychologically to change, if need be, their trades, conditions and the sphere of application of their forces.

From the practical point of view, the future specialist should be trained, in particular, in such

lines of knowledge as would enable him to readily change jobs. Considerable emphasis in the entire educational system and at each of its levels should be placed on the study of fundamental sciences, which have a great methodological significance and change relatively slowly, retaining their validity for a rather prolonged period of time. Thus, "fundamentalisation" of the teaching of engineers, which is much spoken of today, will make it possible to train people for work in the most diverse fields, since they would have solid fundamental knowledge oriented on specific problems and the practical skill to solve them. And this is exactly what is needed to meet the requirements of accelerated scientific and technological progress.

The fundamentalisation of education will make it possible to solve still another problem. In conditions of the STR a qualified specialist should be prepared to work effectively with machines and equipment of future generations. Inadequate qualification is a factor impeding, as some experts believe, the introduction of modern technologies. A specialist must have advanced general theoretical and specialised knowledge that he may apply in case of need, in the future.

Actually, things sometimes testify to the contrary. Thus, an executive of US General Electric stressed that the gap between modern technology and the qualifications of the bulk of engineers

was widening. In his view, knowledge of most engineers lags 5-10 years behind modern engineering, and that of managers 25 years. But it is essential that education should outstrip the development of technology, and this is only possible if there exists a system to constantly forecast the development of science and technology, pinpoint "areas of growth" and make it possible for corresponding areas of education to be developed in good time.

Anticipating the development of technology education acts today as a most powerful stimulus for expanding society's productive forces and accelerating scientific and technological progress. At the same time, this kind of education strikingly reveals the growing role of the human factor in the scientific and technological revolution.

The reorganisation of the entire system of education now under way in the USSR aims at making it more flexible and capable of coping with the ambitious tasks facing Soviet society. The main goal is to ensure its priority development with respect to the proposed technical reconstruction of the national economy.

Great importance in restructuring the entire system of public education is attached to the improvement of the nation-wide system of retraining workers and improving their professional skills. As social life increasingly becomes more dynamic, every citizen of socialist society should

have an opportunity constantly to improve his professional skill and knowledge. It is precisely this approach that helps solve the problem of finding jobs for those who will be apparently relieved as a result of the elimination of many manual, inefficient jobs during a radical scientific and technological reconstruction of the national economy, based on mechanisation, automation, computerisation and robotisation. This approach requires that the traditional concept of the educational system as existing outside production be revised. This includes all kinds of educational services which are today granted to the adult population to make up for the deficiencies of their general and vocational training.

In other words, what is needed is a single system of uninterrupted education subdivided into two equally important subsystems of basic and supplementary education. By basic education we imply the historically formed system of education ranging from school to college. Its function is to mould the intellectual foundations for the development of the individual of a new type and his or her world outlook. That system provides essential knowledge for activity in the production of material or spiritual values and for social activities, presupposing a constant rise in educational and intellectual standards. By supplementary education we mean a single organisational

system of various educational institutions and forms of organised self-education, which should provide, on the basis of the already received basic education, an opportunity to acquire systematised knowledge necessary for efficient production and social activities.

Educational systems enabling one to master new skills and trades give man the possibility to realise many of his striving and ambitions. However, only one who has found his place in life and whose job is a pleasure, can work intensively and creatively, appreciating the results of his work. For that reason, an effective and science-based orientation of the younger generation on their future jobs should be an integral part of the entire system of education and training.

Introduction of computers into the various spheres of activity has a great impact on the development of education. Much is being written in the West about the future or the incipient intrusion of computers in man's everyday life. Experts in socialist countries also deal at length with this subject. In particular, it is stressed that "computer literacy" should be an indispensable part of man's overall culture. The realisation has hit home how important it is to be able to handle a computer. Thus, a public opinion poll in France in 1985, showed that 68 per cent of the respondents consider it to be a priority and very essential. Today, much attention is paid in many

industrially developed countries to training people in that field, giving "computer literacy" to schoolchildren and adults alike.

Though the massive mastery of the ABC of computer work is dictated by the needs of scientific and technological progress, many Western experts make no secret of their apprehensions that massive computerisation may have a negative effect. In particular, it may widen the existing gap between the more educated and the less educated people. Moreover, the specific "computer illiteracy" of the less educated will be responsible for a further drop in the living standards of a fairly large part of the population in capitalist countries.

For even today, in the economically and culturally developed capitalist countries there are many millions of functionally illiterate people who are practically unable to make use of information that is elementary for modern society. Thus, according to various sources, there are today from 18 to 64 million functionally illiterate people in the USA, and their number is growing. If the mass of the people do not acquire a "second", "computer-based" education (and the same kind of barriers will probably arise here as those barring citizens of capitalist countries from receiving formal education), the share of functionally illiterate people may sharply rise, since to them will be added those who cannot process and

use elementary information by means of computers.

The ensurence of universal "computer literacy" in socialist countries started with the introduction in a number of their secondary schools of a new subject entitled "Fundamentals of informatics and computer technology". In a few years, colleges in socialist countries will be enrolling students who have already learned the ABC of computer science. The system of higher education should, therefore, consider this new dimension in future student enrollments. It means that the entire system of training should be overhauled to provide graduates with a solid knowledge of informatics, augmenting the knowledge they received in schools.

Moreover, one should consider the fact that mass computerisation of society would inevitably confront it with a number of complex problems of both a positive and negative nature regardless of the socio-political system. And it is not only a matter of cost and the material resources needed for universal training in computer science. Provision of material facilities is itself a formidable task — more than 1,000,000 personal computers will have to be supplied only to Soviet schools, and, on the whole, as Soviet experts believe, the pool of personal computers in the USSR will number many millions in the early

21st century and hundreds of millions by the mid-21st century.

The wide use of computers makes it necessary that people acquire a new social orientation and a new approach to values, which will not come about automatically. The aim of computerisation is to promote man's positive traits, his initiative, activity, and independence, to elevate human labour and contribute to the harmonious development of the individual. However, as experts point out, it is not ruled out that massive computerisation may be accompanied by rather pronounced negative trends in spiritual life, such as the rise of an utterly utilitarian approach to material, cultural, and moral values. This is a very serious problem and its solution should be sought not so much in the technical as in the social and psychological spheres. Massive informatisation of society is closely connected with its political, cultural, social, and psychological aspects, placing before education and training serious problems. Relying on principal advantages of a planned economy, the collective way of life and a truly democratic political system of socialism, it is necessary to resolve in good time all possible contradictions, providing all the essentials for the development of man's creative faculties.

3. Man's Future Lies in New Technological Civilisation

At the close of the dynamic 20th century, the future of man himself, his place in future society above all, has become the central problem before humanity. What will man of the third millennium be like? Let us try to visualise the world's future horisons and the ideals to which we aspire.

The rapid development of humankind and progress of science, nourish illusions that a new man may be moulded based on scientific and technological achievements and by altering his genetic characteristics. Bourgeois scholars, who believe that conditions of social life cannot transform the spiritual and moral qualities of people today and of their posterity, propose to apply the achievements of molecular genetics to man with the aim of changing his heredity and creating a new human race. Using this, "genetic" method, they think it possible to create a new, humane man, as well as specific races of mathematicians, physicists, writers, workers of various trades, peasants, artists, cosmonauts, people adopted to work in the depths of oceans, etc.

Of course, the tremendous achievements of molecular genetics and promising successes of genetic engineering should by no means be underestimated. The development of these sciences is hoped to rid the people of the various inborn

deseases. As to speculations about the genetics-based remaking of man, as the prominent Soviet genetist, academician Nikolai Dubinin, noted, they are a dangerous delusions. In his opinion, modern science does not have the data on the connection between the genetic differences of people and their respective spiritual qualities and there are no grounds for a purposeful metamorphosis of man's genetic populations.

The man of the future is developing through the flourishing of all his vital forces and his spiritual and physical perfection actuated exclusively under the impact of the social milieu, the experiences of social change and his own material and spiritual activities. Advancing science and technology and changing the material and cultural conditions of his existence, man simultaneously changes himself. Moreover, as distinct from his biological resources, man's social resources, the possibilities of his development and his future, are virtually inexhaustible. For every new stage of scientific and technological progress is at once a new stage of the development of man himself. Development of the entire wealth of human nature implies the development of man as a personality in the process of his material and cultural activity, his relations and communication with other people, education and upbringing. To define what man of the future will be it is, therefore, necessary to analyse the trends of scientific and

technological progress in close connection with social progress.

On the crest of the wave of optimism engendered by the STR revolutionary impact on all aspects of life in modern society, there arose the most diverse concepts of the future of man depicting it as a blissful life in some maximally automated paradise which is run on the state-of-the-art technology and which frees man from all serious obligations to society, giving him the opportunity to devote most of his time to not too burdensome activity and entertainment. Man would be, allegedly, living in a community of "carefree gentlemen" whose work would be to push buttons for a few "working" hours a week.

But this is hardly the case. As we have seen, the STR makes society as a whole and every person's life increasingly more complex. For that society to function efficiently, universally trained workers are needed who wield versatile knowledge and possess a progressive world outlook. In the historic perspective, such a universal worker corresponds to the Communist ideal of a harmoniously developed individual, since it is only Communism, which Marx termed "the kingdom of freedom", that will be able to ensure, alongside the greatest flourishing of the productive forces and social labour, the utmost development of man. Advancement to the "kingdom of freedom" is the aim of social development, which embodies

a historic process of the shaping and realisation of the human essence. It is toward this goal that material production, social relations and the culture of society as a whole should be oriented. General and typical traits of an individual that form the image of the ideal human being of a future civilisation should serve as guidelines for that advancement. This ideal is a harmoniously developed human being, the individual for whom work has become a vital primary necessity and the apex of enjoyment, a person whose free development is the condition of a free development of society. And this society, in turn, makes it its own aim to develop all the human forces. The concept of an ideal is not the product of the mind and its fancies which can lead to the most incredible fictions; it is engendered by the discovery of the objectively existing, law-governed trends of social development. Scientifically substantiated ideals reflect the deep-going trends of social progress, making it thus possible not only to establish the qualities and traits desirable for man of the future but also to determine those which should be inherent in him. In the historical perspective, Marxism asserts the image of human being who is endowed with manifold talents and abilities, an energetic person with creative initiatives possessing a strikingly expressed individuality. Furthermore, in its approach to the future of mankind Marxism proceeds from the proposition that

the role of man is growing in all spheres of social activity. Therefore it emphasises the human aspect in accelerating scientific and technological progress.

As far as 19th century and even the early 20th century, man seemed to be lost against the background of the roaring gigantic machine personifying industry. It seemed that he was doomed eternally to remain one of its tiny cogs. But the STR has radically changed the place of man in the system of productive forces, transforming him from an "elementary" element of the production process into its decisive factor. However, this objective trend is expressed differently in the opposite social systems — socialism and capitalism — exercising different impacts on the position of the working class, its educational and living standards.

Although capitalism's possibilities are far from being fully exhausted, they are nevertheless limited socially. Today, capital is in a position to exploit the intelligence of workers, technicians and engineers just as ruthlessly and intensively as it earlier exploited man's physical powers. Many bourgeois researchers believe that "inputs in man", i. e., in training and teaching, more than repay itself in conditions of developed industry. These utilitarian and pragmatic considerations and needs account, in particular, for the higher educational standards registered in recent years

by the major capitalist countries. We know, however, that these standards are strictly kept to the minimum and reserved for specialised knowledge indispensable to modern production in the economically developed capitalist countries.

This is how the US scientist, Norbert Wiener, defines the ideal of a universally trained worker in an antagonistic society: "Each individual is conditioned from birth for his proper occupation, in which rulers are perpetually rulers, soldiers perpetually soldiers, the peasant is never more than a peasant, and the worker is doomed to be a worker."[1]

Highly qualified work and intellectual activity providing moral fulfilment, are the privileges of an insignificant part of capitalist society, confined as it is to the numerically small intellectual elite. As to the overwhelming majority, their lot remains to perform the monotonous work of doers, and sometimes even meaningless operations.

And indeed, under capitalism the trend towards transforming man into a decisive factor of production operates only as a material precondition of changing his social standing as a worker. An indispensable condition for a universal

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[1] Norbert Wiener, *The Human Use of Human Beings. Cybernetics and Society*, Boston, Haughton Mifflin Company, 1950, p. 60.

worker to become the social rule, not a rare exception, is such an organisation and transformation of social relations as would provide the greatest possible scope for the development of the individual and his all-round perfection. It is, consequently, necessary to unfetter the individual, ridding society of exploitation of man by man, overcoming professional and social limitations in people's activities and freeing them from a morality and mentality based on the omnipotence of private property.

In contrast to the bourgeois system, the opportunity for the all-round development of man in socialist society is not the privilege of a narrow group of the select: it extends to all working people. Of course, to reach that goal will take a prolonged time for it is a complex and many-faceted process linked with the upbuilding of the socio-economic basis of socialism and a radical reorganisation of all aspects of society's life, improving social and political relations, developing and deepening democracy and implementing a genuine revolution in culture. The profound and multiform nature of social change and the pace of the scientific and technological revolution objectively require that the development of man proceed at an equally fast rate.

GLOSSARY

ACCELERATION OF SCIENTIFIC AND TECHNOLOGICAL PROGRESS, strategy for the development of science and technology at the present stage of socialist development; a component of the strategy for an accelerated socio-economic development of the socialist countries on the basis of scientific and technological progress.

ARMS RACE, process of creating and stockpiling increasingly more destructive and efficient systems of weapons and military equipment, instigated by aggressive imperialist circles.

ATOMIC POWER STATIONS, technical installations transforming atomic (nuclear) energy into electricity.

AUTOMATION, application of technical devices in order to totally or partially replace man in obtaining, processing, transferring and using energy, materials and information.

BIOTECHNOLOGY, one of the most important trends in scientific and technological progress, a new, rapidly developing branch of science and production based on the indus-

trial application of natural and purposefully-created living systems.

BRAIN DRAIN, emigration of scientists and technicians, in particular from developing countries, to the leading capitalist countries.

CLUB OF ROME, international non-governmental organisation comprising scientists, political and public figures from many countries who investigate global problems of our time in order to help achieve an understanding of the difficulties challenging mankind and exert influence on public opinion accordingly.

COMPREHENSIVE PROGRAMME FOR SCIENTIFIC AND TECHNICAL PROGRESS OF THE CMEA MEMBER-COUNTRIES TILL THE YEAR 2000, programme for the elaboration, creation and large-scale use of radically new machines and technologies on the basis of profound international specialisation and cooperation.

COMPUTER FETISHISM, extreme exaggeration of the potency of computers in solving socio-economic, political, ideological and other problems of socio-economic development.

COMPUTERISATION, wide-scale application of computers in various fields.

COORDINATING COMMITTEE FOR CONTROL OVER EXPORTS OF STRATEGIC GOODS TO SOCIALIST COUNTRIES (COCOM), set up in 1949 on US initiative to supervise the flow of so-called strategic goods to socialist countries. The US Administration uses it as an instrument to undermine international trade and wage a protracted technological war against socialist states. COCOM members are the NATO countries (except Iceland) and Japan.

COUNCIL FOR MUTUAL ECONOMIC ASSISTANCE (CMEA), interstate economic organisation of socialist states. Established in 1949. It is designed to pool and coordinate their efforts to promote the deepening and improvement of cooperation, the planned development of the economies of its members, the acceleration of scientific and technological progress, the improvement of the industrialisation level of less developed countries, the growth of labour productivity, the evening out of economic development levels and the improvement of the well-being of the population.

ECOLOGY, branch of modern scientific knowledge investigating the laws governing the interaction of plants, animals and man between themselves and their correlation with the habitat.

ELECTRONIC COMPUTER TECHNOLOGY, branch of technology processing information with the help of devices built on electronic circuits.

EUREKA, programme of West European countries in the field of modern technology. The declared goal of the programme is to promote the development of the most advanced trends of scientific and technological progress in the member-countries, enhance their competitiveness on the world markets of science-intensive products and establish a "technologically homogeneous" Western Europe.

FLEXIBLE AUTOMATED PRODUCTION, automated manufacturing system which, being based on appropriate technical devices and organisational decisions, quickly readjusts itself in order to manufacture new products within a sufficiently broad range of output and parameters.

GLOBAL PROBLEMS, spectrum of universal human problems of our time which affect the world at large and individual regions, or individual countries: war and peace, energy, ecology, foreign debts and other problems.

INDUSTRIALISATION, establishment of large-scale machine production in all economic sectors.

INFORMATICS, field of scientific and technical activities associated with the study of the processes involved in the reception, transfer, procession, storage and supply of information, a field dealing with the creation, introduction and application of information techniques and technologies in all economic and social spheres; one of the mainstreams of scientific and technological progress.

KNOWLEDGE, result of cognising reality and its reflection in human consciousness tested by social practice and logically organised.

LABOUR, purposeful human activity aimed at transforming and making use of the objects of nature for satisfying human needs.

MACHINE, technical device whose operation is based on the use of mechanisms and mechanical motion. The term "machine" nowadays is also used in reference to sophisticated technical devices functioning on other principles as well, computers for instance.

MACHINERY, all mechanisms and machines, as well as systems and means of management, extraction, storage and processing of matter, energy and information created for production purposes or serving non-production requirements of society.

MECHANISATION, introduction of machines and mechanisms to replace manual labour.

MODE OF PRODUCTION, historically determined method for the procurement of material benefits; unity of productive forces and relations of production.

NEW INTERNATIONAL ECONOMIC ORDER, concept advanced by the developing countries pursuing the

goal of restructuring international economic relations with the industrially-developed states of the world on a fair and equitable basis.

NEW INTERNATIONAL INFORMATION ORDER, concept advanced by the developing countries for the restructuring of international exchange of information with the world's industrialised states on a fair and equitable basis.

NEW MATERIALS, materials with a qualitatively new combination of properties, also materials recently introduced by industry.

NUCLEAR WINTER, probable considerable and long-term drop in temperature on the continental part of the entire Earth as a result of nuclear war.

POTENTIAL; SCIENTIFIC AND TECHNOLOGICAL, comprehensive estimate of the level attained in the development of science, engineering, technology, potential and resources available to society for tackling scientific and technological problems.

POWDER METALLURGY, production of articles made of metal powder or compounds of metals and non-metals.

PRODUCTION, active transformation of nature by man with the aim of creating necessary material conditions for his existence.

PRODUCTIVE FORCES, system of subjective (man) and objective (means of production) elements reflecting an active attitude of people to nature through the material and intellectual mastering and development of its resources which involves the reproduction of conditions of man's existence and stimulates his development.

RELATIONS OF PRODUCTION, combination of material economic relations between people in social production

and the movement of the social product from production to consumption.

ROBOT, automatic device reproducing the movements or behaviour of living creatures.

ROBOTICS, field of science and technology dealing with the study, creation and use of robotechnical systems, a radically new facility for the comprehensive automation of production.

SCIENCE, systematic knowledge of objects of any nature expressed in forms ensuring its universal, uniform assimilation and comprehension; a special branch of activity designed to attain such knowledge.

SCIENTIFIC AND TECHNOLOGICAL PROGRESS, integral, interdependent advance of science and technology.

SCIENTIFIC AND TECHNOLOGICAL REVOLUTION, radical qualitative change in the integral system of productive forces produced by the interdependent integral process of the development of science, engineering and technology.

STRATEGIC DEFENCE INITIATIVE (SDI), US military programme providing for the deployment of large-scale antimissile system comprising several subsystems based on the use of space vehicles.

TAYLORISM, system of capitalist management of production with the aim of deriving profits by boosting labour intensity to the utmost. Introduced by American engineer Frederick Winslow Taylor (1856-1915).

TECHNOLOGY, all processes, rules and know-how used in the production of a particular item in any field of production.

THEORIES OF "INFORMATION SOCIETY", mod-

ern bourgeois sociological and futurologist concepts based on the premise that informatics, computers and microelectronics determine and transform the entire social system and serve as an instrument of creating new supraclass and supranational social structures which radically change the mechanisms of social development.

TRANSFER OF TECHNOLOGY, import and export of technology at the level of enterprises or countries. In this case technology is perceived as the result of scientific and technological development embodied in material and non-material forms.

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